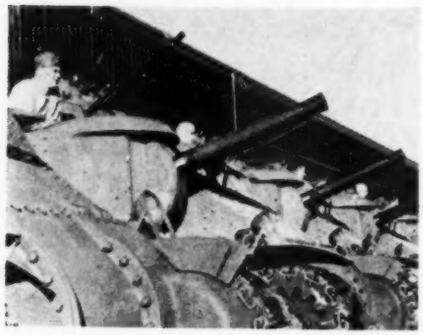
AMERICAN MACHINIST

December 10, 1941



Off the Line—*Medium tanks, ready to go, are lined up in front of the U.S. Tank Arsenal operated by Chrysler Corporation*

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McGraw-Hill Publishing Company, Inc.

Publication office, 99-129 North Broadway, Albany, N. Y. Editorial and executive offices, 330 West 42nd Street, New York, N. Y. Branch Offices: Chicago, 520 North Michigan Ave.; San Francisco, 68 Post Street; Aldwych House, Aldwych, London, W.C. 2; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta.

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VOLUME 85 NUMBER 25

AMERICAN MACHINIST. Copyright 1941 by McGraw-Hill Publishing Co., Inc. Published every other Wednesday. Price 35c a copy. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation, 330 West 42nd Street, New York, N. Y. Subscription rates — United States, Canada, Mexico and Central and South American countries $5.00 a year, $8.00 for two years, $10.00 for three years. All other countries $8.00 a year, $13.00 for two years, $16.00 for three years. Entered as second class matter, September 29, 1936, at Post Office, Albany, N. Y., under the act of March 3, 1879. Printed in U.S.A. Cable address: "McGrawhill, New York." Member of A.B.P. Member of A.B.C.

A McGRAW-HILL PUBLICATION

PRINTED IN U.S.A.

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Coming to YOU
January 22

THE 29th ANNUAL REVIEW & CATALOG NUMBER of AMERICAN MACHINIST

Your 1942 Buying Reference for Shop Equipment, Tools, Accessories, and Supplies, including:

A complete summary of new equipment, materials and parts —introduced to the metal-working field within the current year. Descriptions of more than 1,000 new items, complete with illustrations.

Six major classifications of editorial and advertising pages —1. Machine Tools, 2. Tools & Accessories, 3. Forming Equipment, 4. Heat-Treating, Welding, Cleaning & Finishing, 5. Plant-Service Equipment, 6. Parts & Materials.

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29th
ANNUAL REVIEW AND CATALOG
Number
JAN. 22, 1942

AMERICAN MACHINIST

WHAT'S IN THIS ISSUE

ROY T. WISE

REDUCE TOOL BREAKAGE

Roy Wise, formerly consulting engineer, Union Twist Drill Company, is now Canada's Deputy Machine Tool Controller, Department of Munitions and Supply. He inaugurated an educational program on the correct handling of cutting tools because mortality of these important items had been growing at a terrific rate. Through his efforts, requiring visits to the majority of Canadian industrial plants, breakage has been reduced to a minimum. Mr. Wise's recommendations for selecting, sharpening and applying cutting tools are presented on page 1253. Any shop can use them.

FLAME HARDENING FLAT SURFACES

When flame hardening flat surfaces, you have the choice of three methods. The procedure and equipment for each are explained by J. G. Magrath, Applied Engineering Department, Air Reduction Company, in the current installment of his series on oxyacetylene flame hardening beginning on page 1260.

WORTHY STANDARDIZATION

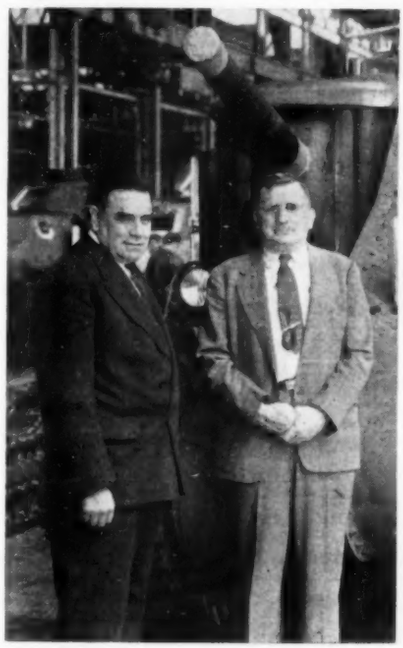
The National Machine Tool Builders' Association has prepared standards for the electrification of machine tools. These are intended to relieve the user of sending with his order for machine tools specific instructions for motors and controls. They are being published in AMERICAN MACHINIST as Reference Book Sheets. The first two will be found on pages 1283 and 1285. These standards are important. They will eliminate the delay, expense and confusion which inevitably results from attempts by the machine tool builder to follow special instructions from the purchaser.

IMPROVED FURNACES

The series on mechanical furnaces is concluded in this issue on page 1256. Mention is made of improvements in batch-type and rotary furnaces which have made these units suitable for continuous production of heat-treated parts. The information will help you secure faster production and lower heat-treating costs.

TANKS START TO ROLL

Within the short space of fourteen months the Chrysler Corporation conceived, planned and built an arsenal for the mass production of M-3 tanks. Today production is 50 percent ahead of schedule. The arsenal is analogous to an automobile plant in size and layout. Everything but major tank components are made on production lines that consist of large general-purpose machine tools usually associated with the building of heavy machinery and railroad equipment rather than automobiles. You'll find details about work on these production lines in the Armament Section, page 1267.



Standardization of machining methods is one reason why Chrysler's production of M-3 tanks is 50 percent ahead of schedule. Much credit for this record goes to E. J. Hunt (left) operating manager of the Arsenal and Lieutenant-Colonel H. W. Rehm, commanding officer

LIEUT.-COL. ROBERT GINSBURGH

INDUSTRY ON THE MOVE

The allocation of war industries throughout the country is changing farm areas into manufacturing centers. Lieut.-Col. Robert Ginsburgh tells you on page 1281 what military and economic factors are involved, and how they will continue to affect our industrial map.

COMING

It is not too difficult for manufacturers of some commercial articles to undertake the production of war material. Take the East Springfield, Mass., plant of Westinghouse Electric & Mfg. Company for example which makes refrigerators, air-conditioners, electric fans and vacuum cleaners. Many of the automatic lathes for machining parts of such items have been retooled for the production of fuzes for light fragmentation bombs. In an early Armament Section this change-over will be discussed, and detailed drawings of the tooling set-ups will be presented.

Quality grinding requires that the wheel be in perfect balance. Factors causing out-of-balance and their remedies will be the subject of an article to be published soon. It was written by H. J. Wills, engineer, The Carborundum Company.

Cincinnati Hypro Planer at Cincinnati
Gilbert Machine Tool Co., Cincinnati, O.

This is a representative illustration of the type of work being done in Cincinnati Hypro Planers in a host of machine tool plants throughout the country. It is more evidence of the time — labor — and cost saving operations that are performed on Cincinnati Hypro Planers. "Foolproof" Power Rapid Traverse . . . instantaneous Rail Lift . . . single turn Rail Clamping Device . . . Selective Dial Feeds . . . Push Button Control . . . Forced Lubrication are few of the design and structural points that make for ease of control — accuracy — and high production from Cincinnati Hypro Planers. Cincinnati offers a range of sizes from 36" to 120" for your flat surface finishing. Want details? Write for bulletin No. 62.

SEND A DOLLAR

For Cincinnati Planer's "Treatise on Planers". A comprehensive treatise on the construction development and application of Planers.

THE CINCINNATI PLANER COMPANY

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ESTABLISHED 1877 **AMERICAN MACHINIST** BURNHAM FINNEY, Editor

More Cuts From Cutting Tools

BY ROY T. WISE, DEPUTY MACHINE TOOL CONTROLLER, OTTAWA, CANADA

It is not necessary to "go easy" in order to make cutters last long. Treat them right, and they will give more and faster cuts

CUTTERS, today, are hard to get. In many plants they are the choke point of production. Manufacturers have demanded more and more machine tools and have installed them in great numbers, but machine tools without cutting tools have no real value.

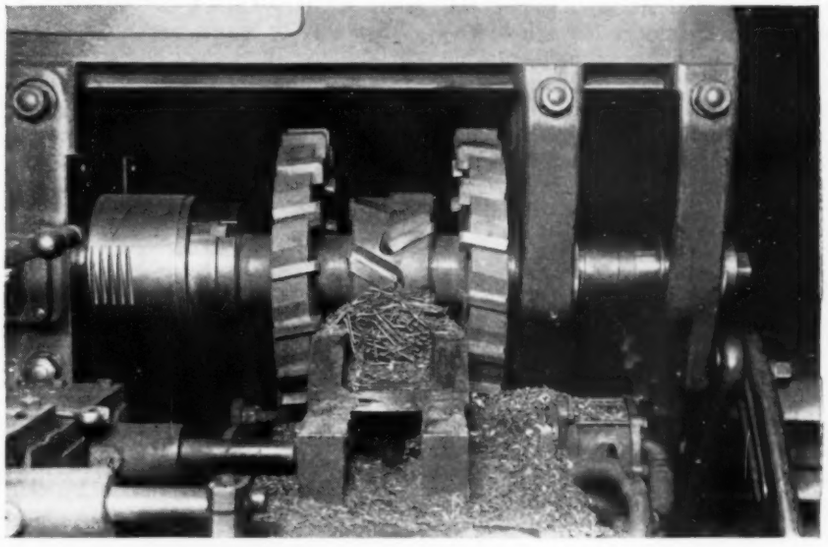
In an emergency, like this one, production is paramount—far more important than savings. However, conserving cutting tools does not mean slowing down or nursing them along. Their life can actually be lengthened while using increased feeds and speeds.

Wastage has been accelerated by the large number of men new to industry now employed in metal-working plants. They know part of their job but not all of it. The proper handling of cutting tools too frequently falls in the sector of inexperience. Education in this direction will serve to add greatly to output at this time when time is short.

To obtain more production from cutting tools three main objectives must constantly be kept in mind:

1. The selection of the right tool to do the work.
2. The proper sharpening of these tools.
3. The application of these tools to produce more parts.

Attention to these points has produced many remarkable results. In one instance a set of cutters was used on an operation in which the total width of cut was 11½ in. The cutters had a slow helix and a radial face on the teeth. The best possible feed was ¾ in. per min. with a poor finish. These same cutters were removed from the arbor and taken to a Barber Colman cutter grinder. The face of the teeth was ground with a 5-deg. rake. The feed was increased to 3 in. per min., and the finish was excellent.



EXAMPLES OF IMPROVEMENT IN CUTTER PERFORMANCE

Old Set-Up			New Set-Up		
Speed r.p.m.	Feed Inches	Pcs. Per Grind	Speed r.p.m.	Feed Inches	Pcs. Per Grind
65	1	150	47	2	300–400
65	1	50	47	2	150–200
65	1¾	40	53	2 13/16	150–200
96	⅞	100	78	1¾	500
36	1.1	100	68	2.8	250–300
75	1⅝	75–150	45	2½	400–500
96	1¾	15–20	96	2 13/16	60–75

Cutters too small for the job constitute a common fault. Many small cutters have too many teeth. Plain milling cutters are frequently used when helical teeth would do much better.

Another example will emphasize the importance of correct sharpening. The job was to machine the side plate for a Colt Browning machine gun; the cut was 4½ in. wide and 14 in. long. It was being machined at 3 in. feed per min., and the maximum number of pieces per grind was twelve. The 52-deg. helical cutter was removed from the arbor, sharpened according to recommended methods and put back to work. The feed was changed from 3 to 7 in. per min., and the cutter produced 48 pieces. Subsequently the average number of pieces per grind for this operation was raised to 60. On a milling machine next to this one, working on the edges of the same plate with a plain milling cutter, the maximum possible speed was only 1 in. per min. A helical cutter used here gave considerable increase in production.

An accompanying table gives some

results of improvements in cutter performance.

The proper application of cutters after they have been correctly selected and sharpened has produced desirable results. In practically all cases the number of pieces per grind of the cutter has been increased 100 percent and from that up to 2,500 percent.

To secure maximum tool life and the best performance from drills, taps, cutters, hobs and all cutting tools:

1. The machine tool on which they are used should be of a design that will provide rigidity to drive the tool through the work without vibration. In the case of cutters, the arbor should be large in diameter and should run true after the cutter is assembled. The work-holding fixture should provide support for the work under the section to be machined and hold it rigidly. The range of spindle speeds should be such as to provide the right number of surface feet per minute for the material to be machined, and feeds that will permit the selection of the correct chip load per tooth.

2. The cutting tool must be correctly designed and made from material that when heat-treated will combine hardness with toughness to stand shock or impact load and resist abrasive wear. It must be sharpened so that the angles back of the cutting edges provide proper clearance and maximum support for the edge of the tool. Grinding wheels must be selected that will not, under proper conditions, wheel burn the cutting edge and draw the temper, but will instead produce a good finish.

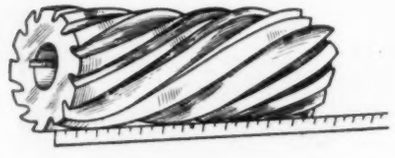
In selecting milling cutters, some of the points to watch are rake angle, helical flutes, flute angle and arbor hole sizes.

Rake Angle facilitates chip removal by the cutter tooth, increasing the efficiency of the milling cutter greatly. The advantage of rake angle is most pronounced in milling ductile material. In general, a rake angle of from 10 to 15 deg. is most satisfactory.

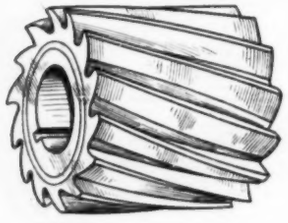
Kent's Handbook defines rake angle of a milling cutter as "the angle by which the face of the tooth is displaced back of the radial line drawn from the center of rotation to the cutting edge."

Helical Flutes offer the advantage of smoothness in cutting because their cutting edges engage the work progressively, thus eliminating chatter and impact. They are recommended for work requiring wide cutters. The helix angle should not exceed 45 deg. in most cases. There are, however, other cases where the full helix angle of 52 deg. is desirable.

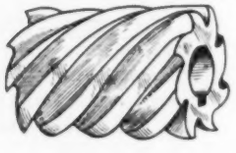
Flute Angle on half side mills and interlocking cutters should be given careful attention. All straddle milling operations should be performed with half side mills. The angle of the flute should carry the chip away from the cut. Staggered tooth mills are not rec-



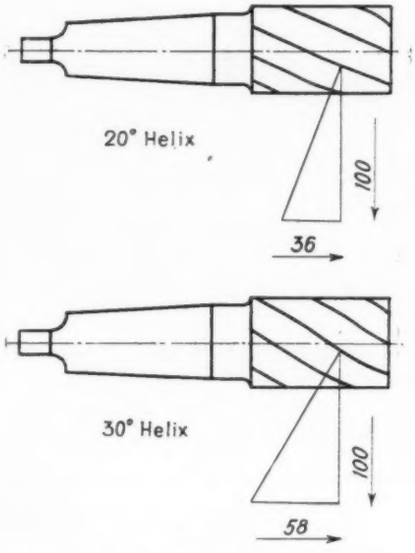
This tool has some of the more desirable features of a correctly designed cutter. It has a helical flute of 45 deg. It has a rake on the face of the teeth and it has been properly sharpened



This milling cutter with a 15-deg. helical flute is not desirable for many operations. It may be useful on light interrupted cuts



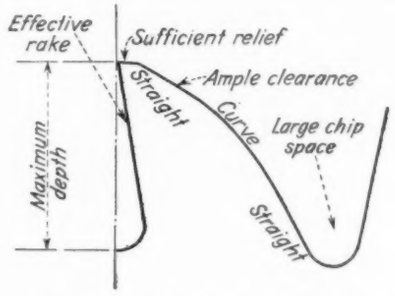
The 52-deg. helical cutter is more generally used today and is preferred to the 15-deg. cutter. In a great many cases a 45-deg. helix is still more desirable



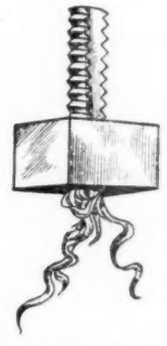
The helical flute for most cutters five or six years ago was about 20 deg. (above). Most end mills manufactured within the past few years have 30 deg. helix (below). The additional helical angle increases the pull out of the tool from 36 percent to 58 percent. Modern holders are designed to resist the tendency to pull out making this effect of little importance in most set-ups

EFFECT OF HELICAL ANGLE on power to drive an end mill

	20 deg. Helix	30 deg. Helix
Total Power	1300	1050
Idle Machine Power	900	900
Cutting Power	400	150



A well designed cutter tooth has a small land with sufficient relief to allow the right feed to be used on the machine. Back of the tooth is a straight line, then a curve, then a straight line and a generous radius at the root. It has ample rake



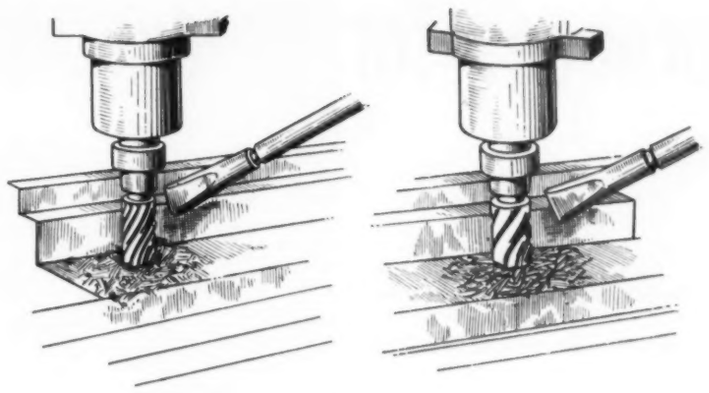
This tap has a left-hand helix and a right-hand cut. All the chips flow out ahead of the cut. It is the same with a helical fluted reamer. This design is of no advantage on blind holes where the chips must flow out along the flute and the helix will only tend to move them the wrong way

ommended for this work. The angle of flute in interlocking cutters should be in a direction that will allow the chip to escape.

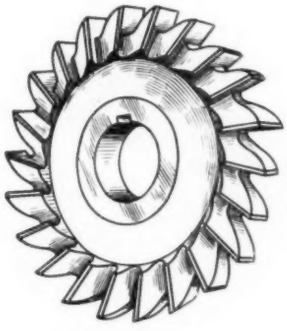
Arbor Holes in cutters should be large enough to provide a rigid drive for the cutter. Large arbors are less likely to be bent or sprung. Arbor holes in cutters should fit the arbor closely. If they do not, the cutter will not run true and only part of the teeth will engage the work.

Selection of the right cutter for the work to be performed will make it possible to use feeds and speeds that will utilize the full productive capacity of the milling machines on which they are used.

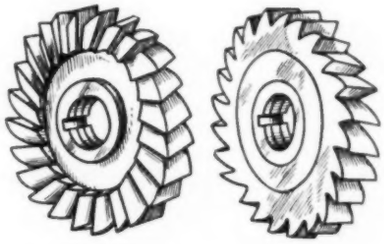
A second article by Mr. Wise will discuss cutter grinding.



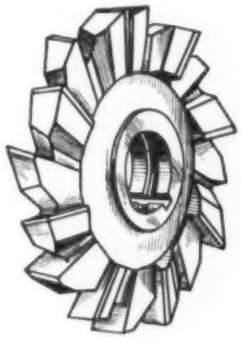
An old cutter with a 20-deg. helix and no rake had a maximum possible feed of 5 in. per min.; a new one with a 30-deg. helix and a 10-deg. rake had a maximum feed of 18 in. per min. Note also that the old cutter has eight teeth, the new one only four



This plain milling cutter with side teeth has a rake angle on the face of the tooth; it is useful on some light cuts but not for straddle milling or for deep slots such as keyways

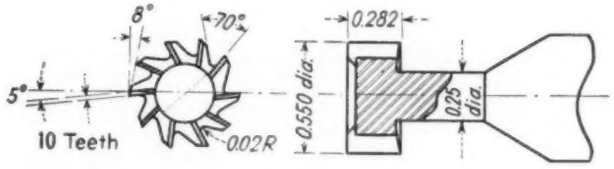


This pair of half side mills is of the type that should be used on all straddle milling operations; it has the advantage of angular teeth providing additional shear cut. It requires less power and will produce two or three times as many parts as the plain side mill

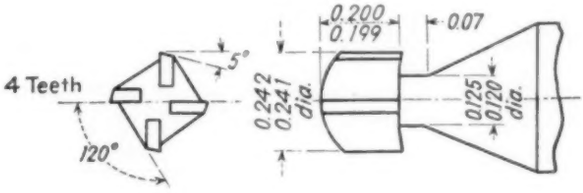


A staggered tooth mill should not be used for straddle milling. It should be used for deep slots, keyways and similar milling operations

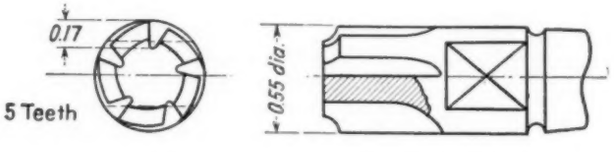
COMMON ERRORS IN TOOL DESIGN



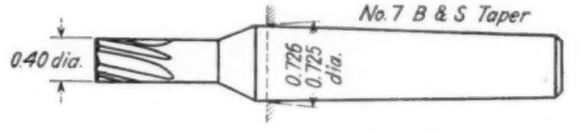
Too many teeth. *This small cutter has ten teeth. Note the small chip space and the thin section at the root of the teeth. This cutter should not have more than six teeth and possibly only four*



Not enough relief. *A 5-deg. relief is indicated for this $\frac{1}{4}$ in. diameter cutter. Since it takes 13 deg. 40 min. to clear the land and provide 0.002 in. back drop on a $\frac{1}{2}$ in. cut, obviously a 5-deg. relief would not clear the heel of a $\frac{1}{4}$-in. cutter. The relief should be indicated in thousandths rather than angle*



Not enough chip room. *There is very little chip room in the flute and the tooth is so thin at the root that the build-up of chips will push the teeth off*



Too much shank. *This cutter could be designed so it could be held in a universal holder rather than using this type of taper shank*

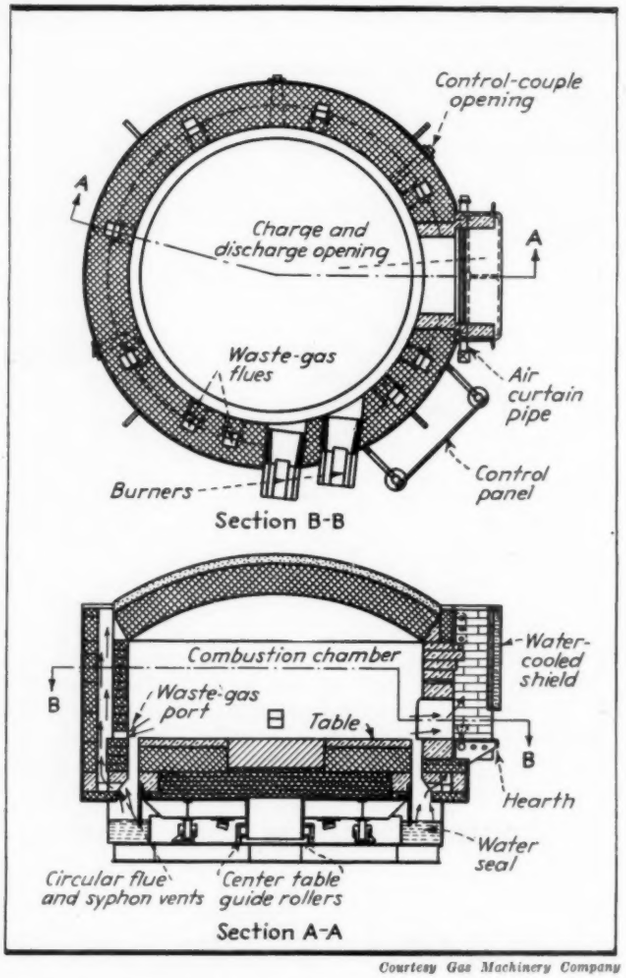
Furnaces for Production Heat-Treating

BY RUPERT LE GRAND, DETROIT EDITOR, AMERICAN MACHINIST

4 — Rotary and batch furnaces find wide use throughout the metal-working industry. Their characteristics are discussed in this article

THE ROTARY-HEARTH furnace is a continuous type that conserves floor space and handling labor. It has high productivity on such operations as heating for forging, annealing, hardening, tempering and clean heat-treating with protective atmosphere. Usually, the furnace is designed to handle one type of operation rather than for universal application. Work may be loaded and removed either manually or automatically. Chief applications are found in the heating of billet steel prior to projectile piercing, heating the end of projectile forgings prior to nozing, gear hardening, as well as heat-treating operations on miscellaneous castings or machined parts and special processes such as heating bearing metals in a protective atmosphere. The work need not be symmetrical, since the parts are merely laid on the hearth, or inserted in fixtures or on rails as the rotating element moves past the charging station at each revolution.

One position normally suffices for loading and unloading, and the operator is often able to work upon related jobs, such as placing gears in the fixtures of Gleason quenching machines. On high-output rotary hearth furnaces the number of operators required depends upon the number of pieces handled per hour, the bulk of the pieces, or both factors. With small pieces conveniently handled with tongs, a single operator can perform the charge and discharge operations at the rate of 360 pieces per hour. Furnaces with capacities in excess of 5,000 lb. per hr. have been handled by one man. On the other hand, one operator may be required for charging at one door and a second man at an adjacent unloading station because of the effort expended. An example is that of rotary hearth furnaces



Courtesy Gas Machinery Company

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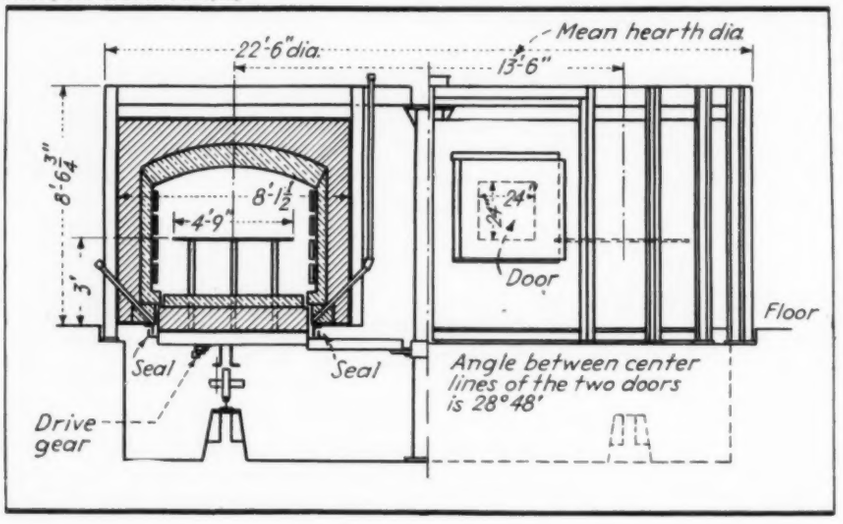
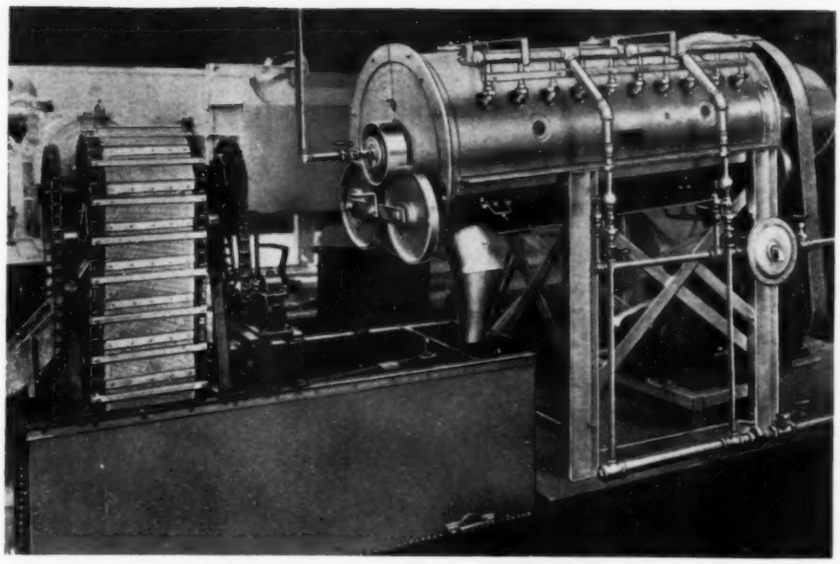


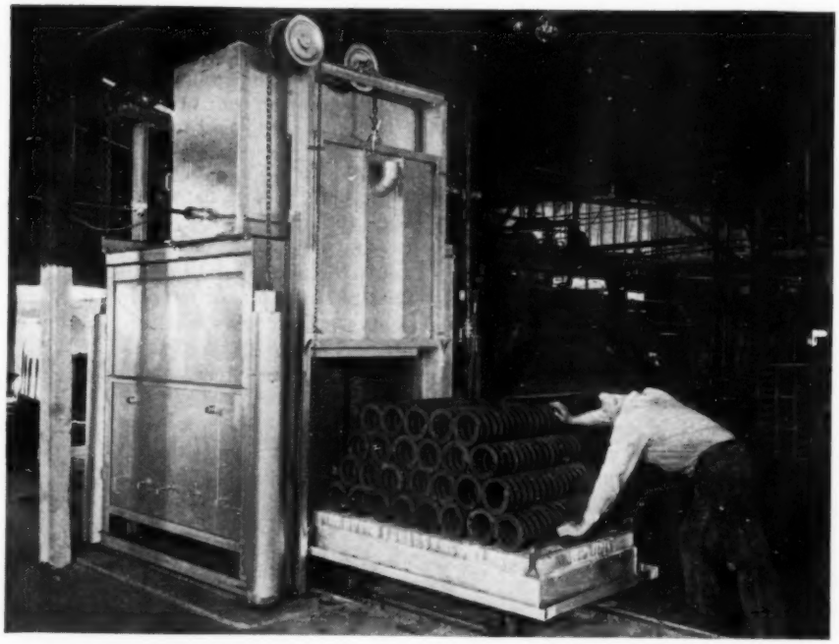
In this rotary furnace the hearth rotates and the side walls and roof are stationary. Burners fire tangentially through the side wall. A water seal prevents escape of gas from the space between stationary furnace wall and rotating hearth

Rotary-hearth furnaces are often built with an annular or "doughnut" hearth, which achieves the effect of a long tunnel-type furnace. This construction provides for slow heating, necessary with some grades of steel to avoid cracking or splitting if subjected to too high an entrance temperature



Courtesy American Gas Furnace Company

Built for gas-carburizing 300 lb. of self-tapping capscrews per hour, this rotary-retort furnace operates on a continuous and uniform time-temperature cycle, because the work is automatically picked up from the hopper and advanced at a constant rate of speed through the horizontal retort by means of internal spiral ribs



Courtesy Surface Combustion Corporation

Car-bottom furnaces are built in any size for batch heat-treatment purposes. This comparatively small convection-heated furnace is used to stress-relieve springs for artillery

for heating 3,000 to 5,000 lb. of sawed billets per hour for projectile piercing. If the piece is large and must be handled by an air hoist or monorail tongs, the operator's speed is necessarily limited. For exceptionally heavy pieces, power-operated charging forks are required.

Improved designs of hearth, rotating mechanism and seals have overcome early faults, such as warping and binding, wedging of work pieces between rotary and stationary elements, and choking with scale. The entire furnace may be revolved past stationary burner equipment, or only the hearth rotated, the side walls of the furnace and ceiling then being supported from beams. Unit loadings per square foot of hearth area may range as follows: for tempering, 20 lb.; for heat-treating, 45 lb.; for annealing, 60 lb.; for forging, 85 lb. Annular-hearth furnaces have been built to accommodate pieces weighing 2,000 lb. each, 25 pieces or more per load, on long heating cycles. Work can often be arranged in several concentric rows to increase the hourly output. Burners are arranged to provide the proper temperatures in the various zones. Heating of the work is uniform, because it rests on the hot hearth and is subject to radiation and convection on the sides and top. Rotary-hearth furnaces have been built with table diameters from 2½ to 55 ft.

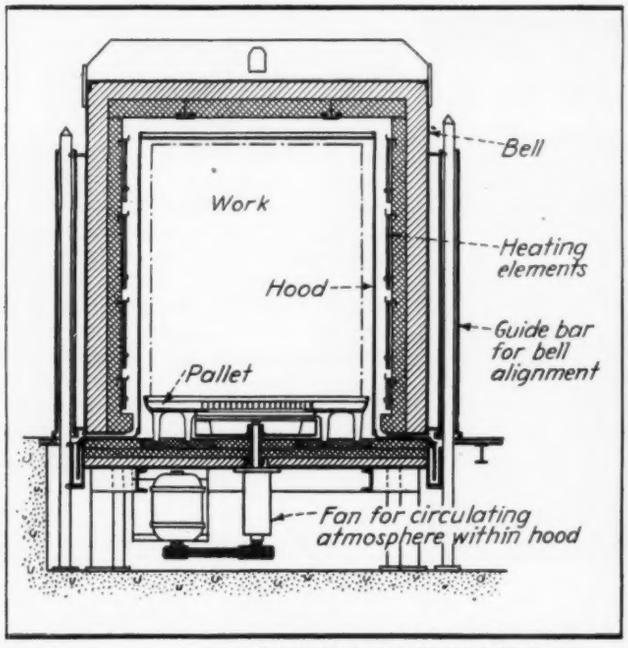
Rotary-retort furnaces are continuous-production heat-treating machines that do not require an operator for feeding. A quantity of work is charged periodically into the hopper. The work is picked up from the hopper by an automatic feed arrangement and fed into the horizontal retort in which it is advanced toward the discharge port by an internal helix. Sometimes, longitudinal ribs are added to achieve a slight tumbling action to aid gas carburizing. As the work leaves the retort, it falls through a closed chute and into a quench tank. The number of helixes in the retort and the heating time required determine the speed of rotation and rate of mixing of a fairly deep layer of work. The heating cycle can be altered as desired by a variable-speed drive to the retort.

This type of furnace is built in capacities from 75 to 1,400 lb. of work per hour. In the smaller machines, the parts heat-treated may be lock washers, balls, rollers, bearing cups and cones, and small machined parts. The largest units will accommodate such pieces as forgings for universal joints, heavy chain links, bolts and nuts.

Processes that can be handled in rotary-retort furnaces include: gas carburizing, clean-hardening with protective atmosphere, continuous annealing and normalizing.

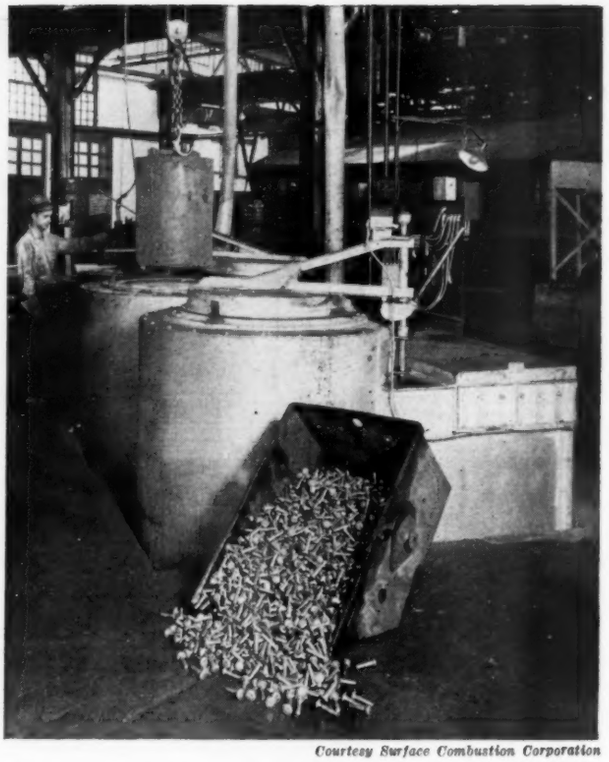
BATCH-TYPE FURNACES

American industry is placing more emphasis upon batch-type furnaces for annealing, normalizing and stress-relieving operations. With such equipment, which can be built in sizes to handle small or large work in various quantities, it is possible to lay out the cycle to secure the most efficient expenditure of labor. The cycle can be planned so that it occurs at a stated interval throughout the working day, and operators busy themselves with other tasks in the meantime. The cycle is made to suit the product, the process involved and the needs of the factory production scheme.



Courtesy Westinghouse Electric & Mfg. Company

Bell-type furnaces have undergone considerable refinement in recent years. An alloy hood is placed over the charge, and protective atmosphere can be circulated within the hood to speed up heating to process temperature and cooling down. The hood is left over the charge during the cooling cycle, and the heating bell is transferred to another charge under a similar hood



Courtesy Surface Combustion Corporation

Bolts, cartridge cases for small-arms ammunition and similar small parts are conveniently heat-treated in forced-convection pit-type furnaces

Batch furnaces are built in a number of types, of which the following are the most common: (1) car type, (2) bell type, (3) pit type, (4) box or oven type, (5) pot type, and (6) elevator type.

Car-type furnaces are built in any required size for annealing or normalizing locomotive frames, gun mounts, artillery springs, castings and fabricated articles in endless variety. Brass cartridge cases are being stress-relieved in car-type furnaces when the production quantities are not sufficient for continuous equipment. In the larger car-type furnaces it may be feasible to run the cars into the furnace from one end only. Smaller furnaces are kept in more continuous operation by arranging doors and track at opposite sides. Thus, when a charge is withdrawn from one side, a new one may be run in from the opposite side and a new cycle commenced with minimum delay and loss of heat.

Bell-Type Furnaces

Bell-type furnaces are built in rectangular or cylindrical designs. The round type is used principally for coils of ferrous or non-ferrous strip, spools of wire, baskets of forgings or castings, although stampings that will stack can be piled upon the base, or pallet. Rectangular bell-type furnaces are ordinarily of greater capacity than the circular form and are employed principally for annealing or normalizing bundles of sheet or long bars, or large parts that can be stacked.

As the name implies, the side walls and roof of a bell-type furnace are made in the form of a bell which is dropped over the charge resting on a base, or pallet. Heating elements line the bell. To speed up heating cycles, it is customary to employ two or more bases with each bell. The charge, placed on the pallet, is covered with an alloy-steel hood, or "hat", under which the charge can be cooled slowly while the bell is transferred to another hood. The atmosphere within the hood, usually of a protective type, is circulated by fans to speed up the heating and cooling of the contents.

Pit-type furnaces are utilized for much the same purposes as the bell type. In some cases, pit-type furnaces are merely over-sized pot furnaces sunk in the floor to achieve sufficient crane headroom to lift off the cover and remove the work container. For heat-treating long shafts, gun jackets and tubes a building of sufficient headroom is required to handle the work into pit furnaces practically level with the floor. Four to twelve jackets and tubes are suspended from a central rod and suitable fixture. The fixture and load may be supported on swinging beams above a split cover, the halves of which are moved aside for putting the load into the pit furnace and removing it. Sometimes, solid covers sealed to the top of the pit furnace are employed, the cover and load being transferred as a unit to the quench tank and draw furnace. This construction permits protective atmosphere in the high temperature furnace if required. Pit furnaces may also be employed for shrinking operations at lower temperature.

Box Furnaces

One of the most widely used types of furnaces is the box type. These furnaces are used for almost any type of heat-treating where large-quantity production is not essential. In some cases, where a wide variety of parts are to be treated, they have been found to be desirable even for large-quantity production.

Two general types are available: one which uses no protective atmosphere is used for heat-treatments where oxidation is not of consequence or where the material to be treated is inclosed in a box such as in pack carburizing.

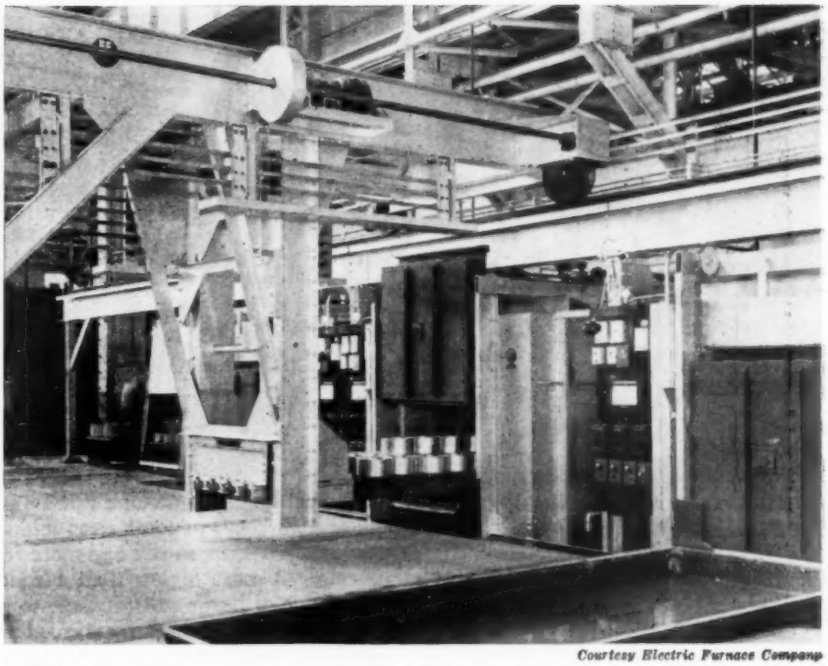
The second type of furnace utilizes a protective atmosphere to prevent oxi-

dation and decarburization of the steel. These furnaces are equipped with a flame curtain to prevent entrance of air and loss of protective atmosphere when the furnace door is opened. For scale-free non-decarburizing treatment the protective atmosphere must be free of CO_2 and extremely low in water-vapor content. Such protective atmospheres are normally produced in a device separate from the furnace, although in some cases they are built as an integral unit.

For hardening, annealing or gas carburizing small parts in quantity, the pot-type furnace is frequently employed for batch operation. A parts basket is dropped into the well of the furnace, the cover placed in position and either products of combustion or protective atmosphere circulated by means of fans. Dense loads of small parts can be properly heated by use of the convection principle.

Elevator Furnaces

Elevator-type batch furnaces are built for a variety of purposes. The two-chamber design has found use for such operations as annealing malleable-iron castings. Low- and high-temperature chambers provide maximum output, give an economy that approaches that of continuous furnaces. Castings are loaded in light-weight containers, eliminating the labor of packing and use of packing material. Since the charge is withdrawn from the bottom, changing the charge in the chamber does not unduly cool the furnace, because the heat is trapped.

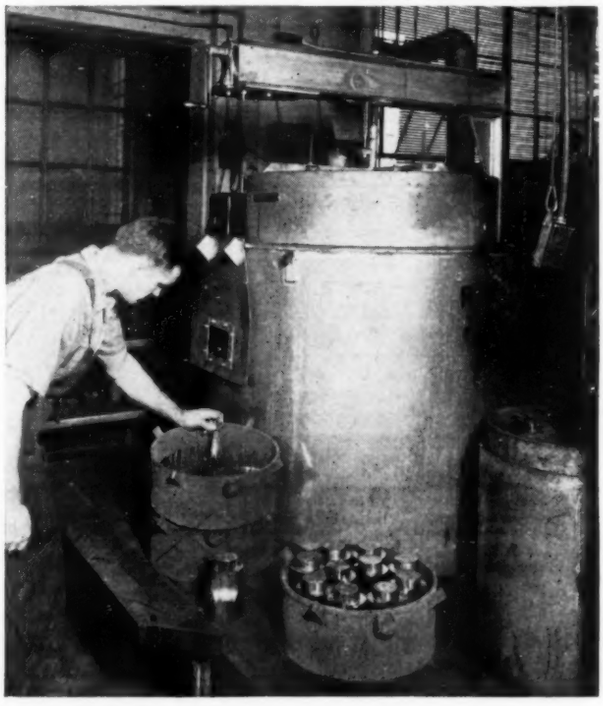


Courtesy Electric Furnace Company

Batch-type furnaces can be arranged side by side with a traveling crane in the front bay to handle work between them. Here a special charging crane with fingers has picked up a load from the hearth of a hardening furnace, preparatory to transferring the work to the quench

The aircraft industry and its requirements for heat-treated aluminum-alloy sheets have brought about development of a single-chamber elevator-type furnace, in which heat requirements are under close control and rapid heating is an important feature. The sheets are suspended from a special rack, which is lowered into the quench tank by a high-speed hoist. The furnace is provided with automatic quench control, the hoist mentioned, and recirculation air heating. Temperatures up to 1,400 F. can be obtained. Roller conveyors are provided for handling the loaded work rack to and from the furnace.

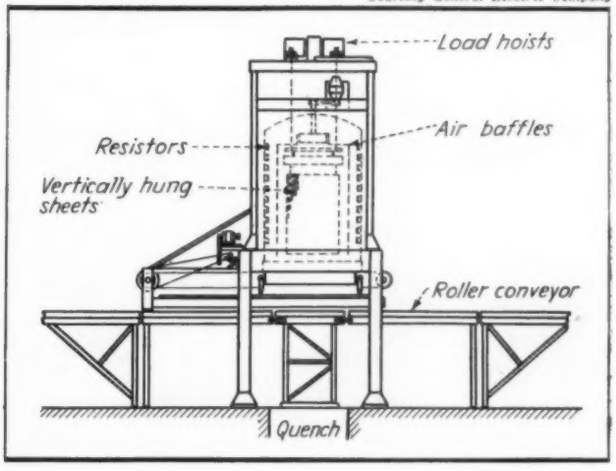
Courtesy General Electric Company



Trays of work are prepared for loading into a pot-type gas carburizing furnace. Fan circulation promotes fast heating, uniform temperature and depth of case

This elevator-type furnace for heat-treating aluminum-alloy sheets suspends the work from a rack, which can be plunged rapidly into the quench

Courtesy General Electric Company



Flat Surface Hardening

COMPILED BY J. G. MAGRATH, APPLIED ENGINEERING DEPARTMENT, AIR REDUCTION COMPANY

The choice of three methods of flame hardening flat surfaces depends on the area of the work

FLAME HARDENING is flexible, allowing the use of a number of methods for producing desired results. It is possible, and frequently necessary, to use different procedures when hardening similar parts of different size. The best known methods are:

Flat Surface Hardening

- Spot Method
- Unit Area Method
- Progressive Method

Round Surface Hardening

- Circular Band Progressive Method
- Spiral Band Progressive Method
- Circular Band Spinning Method (Band Spinning)
- Progressive Method

The spot method is the simplest flame hardening procedure. It is applicable to small or local areas seldom more than 4 sq.in. in size and more frequently on areas of less than 1 sq.in. It consists of heating of the zone to be hardened to above the critical temperature, then removing the flame and quenching with a spray or bath quench, or sequence of both, as illustrated in Fig. 38. Standard oxyacetylene welding torches may be employed with single-flame heating tips for areas not over ¼ sq. in.; or two, three or larger multi-flame tips, for larger areas. See Fig. 17.

Water-cooled torches and water-cooled multi-flame tips without quench may be used on larger areas. The parts to be flame hardened may be placed on conveyor belts traveling past the operator, who applies the flame, immediately followed by the quench, applied automatically or manually. The conveyor, with the parts, may travel almost entirely submerged in water, or the parts may be almost totally submerged in a stationary bath of circulating water and, upon completion of the flame application, knocked over and the treated surface fully submerged in the bath. Or the conveyor may carry the parts beneath a prolonged spray quench.

The spot method is frequently made completely automatic. In a machine, the parts are dropped by an automatic feeding device into the correct position for automatic flame application, then released to drop into a quenching medium and thence to a conveyor for the next production line operation.

For mass production flame hardening by this method, a water-cooled tip can have a built-in automatically operated quench, allowing for tip and torch unit to remain in a fixed position. Upon completion of the flame application, the flames are extinguished and

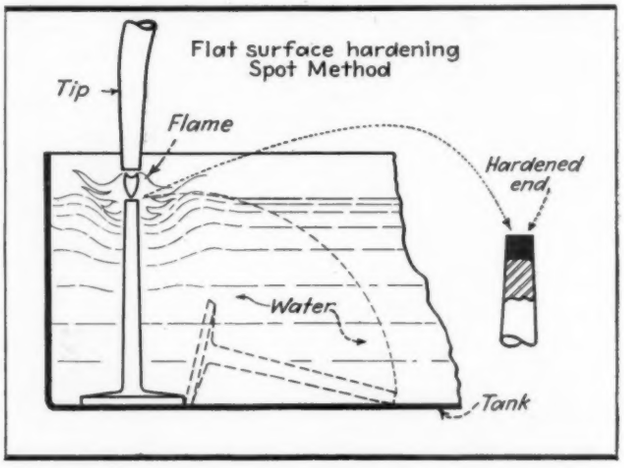


Fig. 38—*One method of hardening by the spot method is to stand the work in water with only the portion to be hardened projecting*

Fig. 39—*These small malleable iron fuel pump levers engine rocker arms and transmission shifter forks have been spot flame hardened on working areas*

the quench applied. The part is removed, and succeeded by the next part. The tip automatically relights to repeat the cycle.

Examples of small malleable iron parts flame hardened with the spot method procedure are shown in Fig. 39.

The procedure for the unit area method differs from the spot method in that generally larger areas are to be treated than can be heated with a stationary torch. The torch is moved backwards and forwards with a reciprocating motion on flat surfaces, and with an oscillating motion on flat surfaces, and with an oscillating motion on concave surfaces, in order to cover the full area to be hardened, and to supply sufficient heat input to raise the surface temperature to above the critical. This motion may be provided manually or mechanically. When the hardening temperature is reached, the flames are extinguished, or removed, and the entire unit area is quenched. See Fig. 40.

Welded Rail Ends Hardened

A typical example of the unit area procedure is shown in Fig. 41. This is the Graham Rail Hardening Machine employed on railroad maintenance-of-way for rail-end flame hardening. Constant pounding of locomotive drivers and car wheels over untreated rail joints eventually result in rail-end batter. The surfaces are then rebuilt by welding, ground smooth and surface hardened by this process. A tip similar to that shown in Fig. 40 is employed. This machine provides for full mechanical control. The tip is automatically lighted then, with a reciprocating motion, raises the rail head surface to above the critical. Automatic quenching with water follows. All operations are accurately time controlled. The drawback heat comes from the residual heat in the rail, and a uniform hardness gradient is obtained from the top of the rail to the unaffected metal.

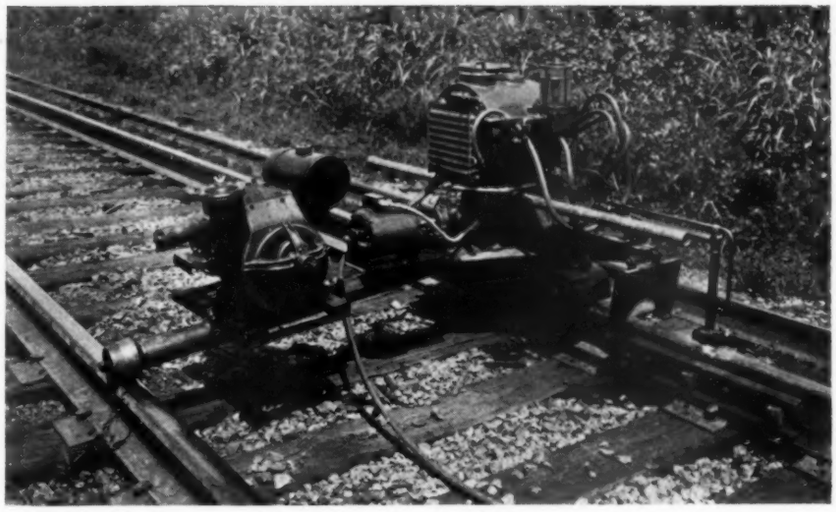


Fig. 41—*Rail ends are hardened on maintenance-of-way with the Graham rail-hardening machine*

Where a narrow band of $\frac{1}{2}$ in. or less and of several inches in length is to be so treated, a standard welding torch with large single flame-heating tip can be used. On wider widths a two, three or larger multi-flame tip may be necessary.

Where larger widths with heavy metal mass beneath are encountered, a water-cooled torch with water-cooled multi-flame tip will be advisable. These are available with separately operated water quenches which allow for heating the area with a reciprocating motion, then flooding with the quench medium. This procedure and apparatus lends itself to full automatic operation.

Mechanical control of the flat progressive method is essential to its success. As is shown in Fig. 42 *a* the flame and quench are passed over the surface at a uniform speed, the flames preceding and heating the surface above the critical for a depth dependent upon the speed of travel and heat input volume, and followed by the quench which uniformly hardens the area heated, leaving the zone beneath unaltered.

A water-cooled torch with a water-cooled multi-flame tip with built-in quench, or with a separate quench immediately following, may be employed. The torch may be travelled across the stationary work, Fig. 42 *b*, or the torch may be stationary and the work travelled beneath or past the flames Fig. 42 *c*. Speeds will range from 2 in. per min. for a hardness depth of $\frac{5}{16}$ in., to 6 in. per min. for a $\frac{1}{16}$-in. depth, subject to variation with the thickness of the object heated.

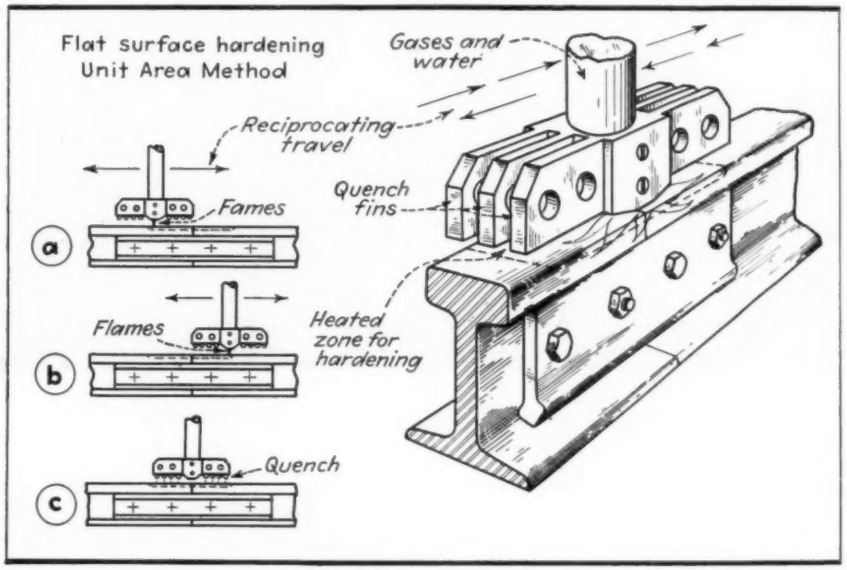


Fig. 40—*In the unit area method the flame is reciprocated to heat the work before the quench is applied*

Progressive Method Used on Blade

A simple example of the flat progressive method of flame hardening is illustrated in Fig. 43. In this instance the torch is held in a radiagraph and travelled along a 10-ft. long bulldozer blade, 10 in. wide and $\frac{3}{4}$ in. thick. A path 2 in. wide was hardened along the wearing edge at a speed of 8 in. per min. To overcome upward pull, the blade was drawn down $\frac{1}{2}$ in. at each end. (It could be bolted down straight and tight to a heavy I-beam).

Another example of this procedure is the surface flame hardening of the inside bearing surfaces of locomotive

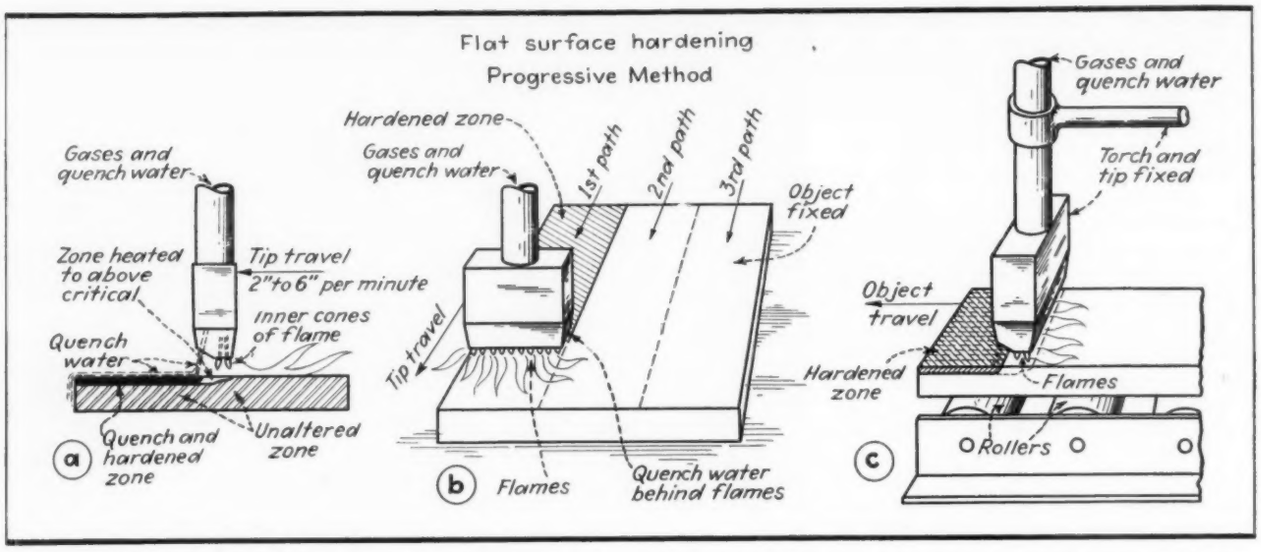


Fig. 42—*Either the work or the torch may move in the flat progressive method; speed depends on depth of hardness desired and the dimensions of the workpiece*

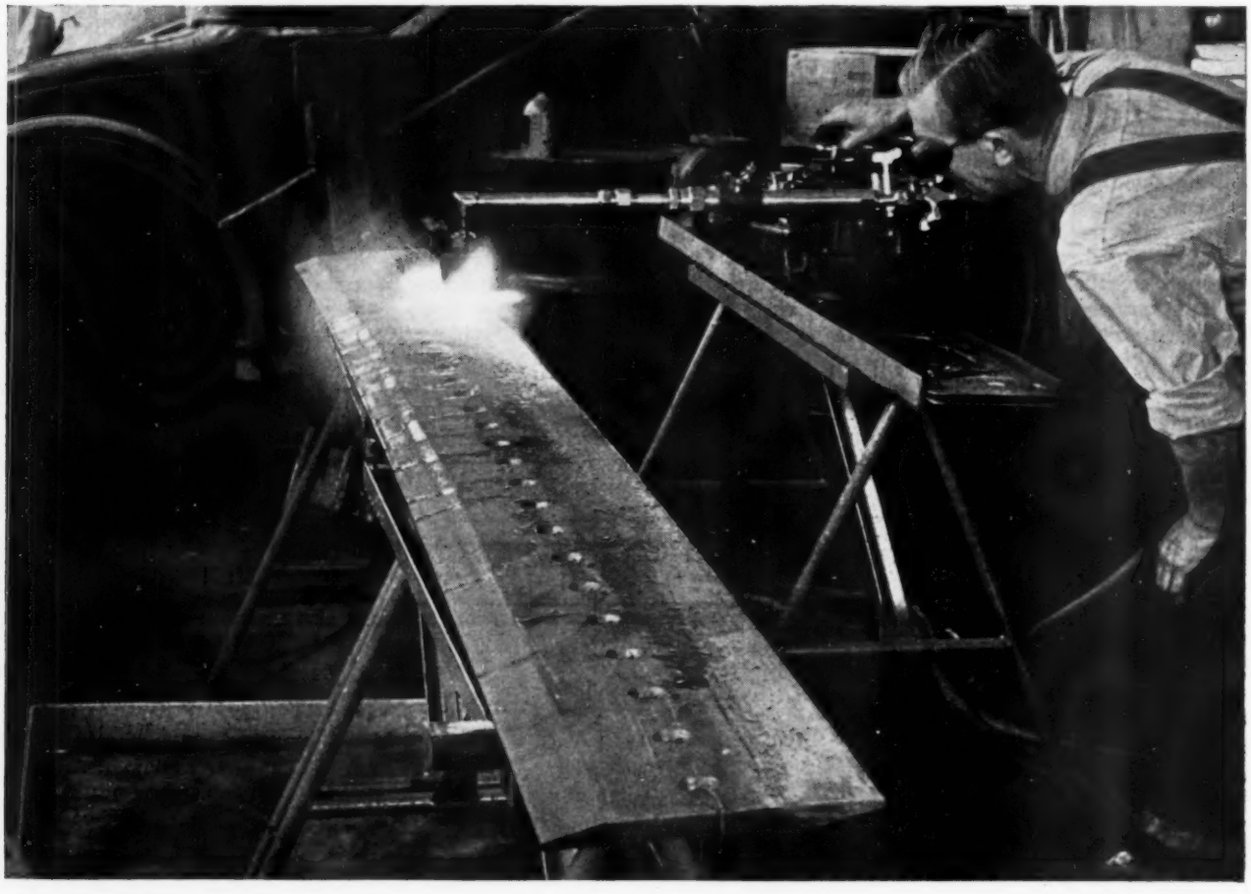


Fig. 43—*The wearing edge of a bulldozer blade is flame hardened by the flat progressive method*

valve gear links as shown in Fig. 44. The width of this bearing surface is 3½ in. and can be treated with a tip 3 in. wide, the outer flames being kept ¼ in. in from the edges. The links are positioned stationary and the torch, mounted on a radiagraph, is travelled along the bearing surface at a speed of 6 in. per min. A close check for warpage or distortion showed that the surfaces had spread apart only 0.0006 in., a remarkably small amount.

In the progressive procedure the quench must be placed in a position and at such angle as not to interfere with the flames. If it is too far away from the flames, the metal is partly cooled before the quench reaches it and

then it is insufficiently hardened. If it is too near the flames it may interfere with them or the heating of the metal and the result is the same—insufficient hardness. An uneven rate of quench (pressure or volume) will result in hard and soft spots which, of course, should be avoided.

As wide a tip as available should be employed when hardening objects wider than the maximum width tip, and several successive parallel passes made to complete the full width as indicated in Fig. 41 *b*. If the part, for example, is 9¾ in. wide then a 3 in. wide tip should be used and three parallel passes made. Generally the given width of the tip is equal to the center-to-center of the extreme outside flames.

The heating effect of a tip extends some ⅛ in. or slightly more beyond the end flames. At the outside edge of the part on the first and last passes there is danger of burning, or at least overheating, with possible checks or cracks, if the flames are played too close to the edge. Therefore, the outside flame should be travelled at least ⅛ in. in from the edge. There will be sufficient heat conducted through to the edge to assure sufficient hardening with the trailing quench. Three passes of 3-in. wide tip will fully provide for the 9¾-in. wide object.

Space Left Between Passes

Frequently it is desirable to allow a ⅛-in. interval between the passes, depending upon the side heat travel and quench effectiveness to the right and left of the forward moving flames. Although the depth of hardened area may be slightly decreased and the surface hardness in this interval be slightly less, as hereinbefore discussed, frequently this is not objectionable. In this case, with ⅛-in. intervals between passes and ⅛-in. set-back from edges, three passes of the 3-in. tip will surface-treat a full width of 10 in.

When hardening wide areas of the higher carbon or sensitive alloy steels, it is advisable to allow wider soft zones between passes, to prevent checking. Where the softened intermediate zones are objectionable then care must be taken to minimize such effect and the side quenches detailed in Fig. 36 employed to narrow this zone and to prevent, as much as possible, the drawing of the hardness from the adjacent path already hardened.

It is occasionally desirable to eliminate the softened intermediate zone entirely, or at least broaden the area of one pass on flat objects that can only be flame hardened with the progressive method. In such instances the width of pass can be increased by employing multiple torches with a series of wide tips, end to end, and with flame and quench orifices so positioned, close to the edge, that the spacing between all flames, position regardless, is fairly uniform as indicated in Fig. 45.

A variation of the flat progressive method is shown in Fig. 46. While this part is being hardened with the torch and tip travelled in a circular path, this procedure is still classed as "flat" progressive and is not to be confused with the "circular band" progressive method. In this instance the torch is mounted on a radiagraph which, with the aid of a radius rod, travels the tip in a circular path of any required dimension.

The next installment of this series will appear in an early number.

Fig. 44—*Another example of progressive flat hardening is this set-up for the inside bearing surfaces of a locomotive valve gear link*

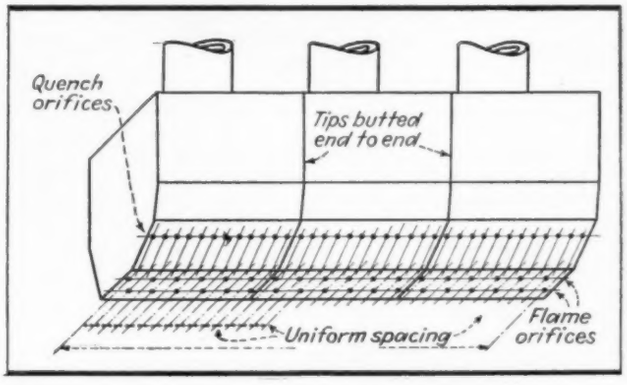


Fig. 45—*Wider paths can be hardened in one pass by using multiple tops with uniform flame and quench orifice spacing*

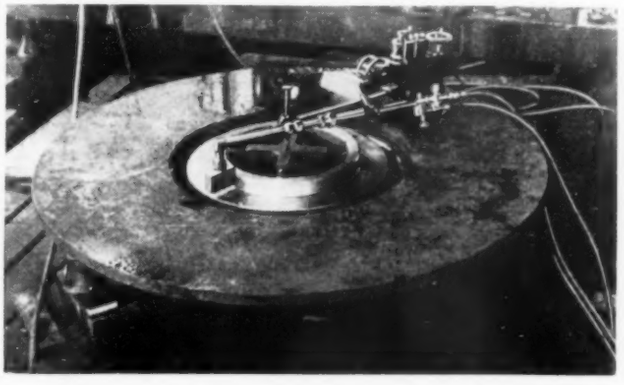


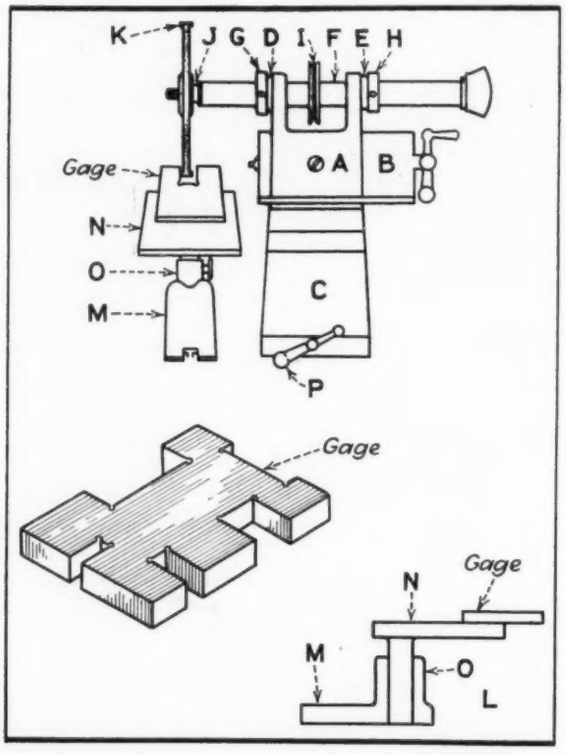
Fig. 46—*A variation of the flat surface progressive method applies the flame in a circular path with the torch swung on a radius rod*

IDEAS FROM PRACTICAL MEN

Set-Up For Grinding Snap Gages

BY GUS HAESSLER

The device shown in the drawing was devised for the special purpose of grinding snap gages to size. The assembly consists of a slide-rest grinder *A* fitted to the T-slot of the toolblock operating on the upper slide *B* of the slide rest *C*, the whole being clamped to the bed of a bench lathe. The housing *A* carries two hardened, ground and lapped bushings *D* and *E* fitted on the hardened, ground and lapped spindle *F*. Similarly finished colalrs *G* and *H* are adjustable on spindle *F*, being secured by setscrews.



Snap gages can be ground accurately with this set-up, which includes a slide-rest grinder mounted on the bed of a small bench lathe

The driving pulley *I* can be placed anywhere on the spindle.

A grinding wheel mandrel *J* with a taper shank fitted into the spindle *F* takes wheels of various thicknesses, which are dressed so that the periphery *K* is the only cutting point of the wheel. The narrowest slit in the snap gages to be ground depends of course upon the thickness at which the wheel will stand up. The widest slit will depend upon the distance that the slide-rest grinder *A* can be moved without disturbing the setting of the slide rest *C*. When one side of the slit is ground, the grinding wheel is simply moved over to the other side by means of the feedscrew handle, the operation being repeated until the slit is ground to width. However, its practical range will cover all sizes contained in the gage shown in the drawing.

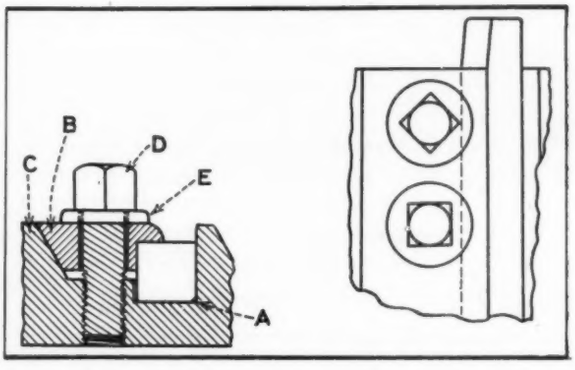
The snap gage is held on the assembly *L*, which consists of the bench-lathe *T*-rest *M* reversed, with the bolt replaced by platen *N*. This platen has a straight shank which is a sliding fit in the hub *O*, providing both horizontal and vertical adjustments. It is secured by thumbscrews, the whole being bolted to the lathe bed.

In preparing to grind a gage, it is first clamped to the platen *N* and adjusted vertically so that a line at the center of the thickness of the gage is approximately the same height as the center line of the spindle *F*. It is secured in that position. By operating the feedscrew handle *P*, the grinding wheel is moved to the surface to be ground. When the gage is approximately parallel to the side of the wheel, the reversed *T*-rest is bolted to the lathe bed, using C-clamps or straps. This is a satisfactory way of grinding snap gages, and we are using it sucessfully every day.

Rigid Toolbit For the Heaviest Work

BY MARTIN H. BALL

The illustrated clamp was designed for holding toolbits when taking the heaviest cuts for which they can be used. The groove which forms the seat for the toolbit is made a very free fit in width for the bit. The corner of the bit diagonally opposite its cutting edge is relieved slightly at *A* to make sure



This toolbit clamp, based on the wedge principle, is almost as rigid as a solid block

that there is nothing to hinder a perfect fit on the bottom and side of the bit when pressure due to the feed or depth of cut, is exerted on the opposite side or top of the toolbit.

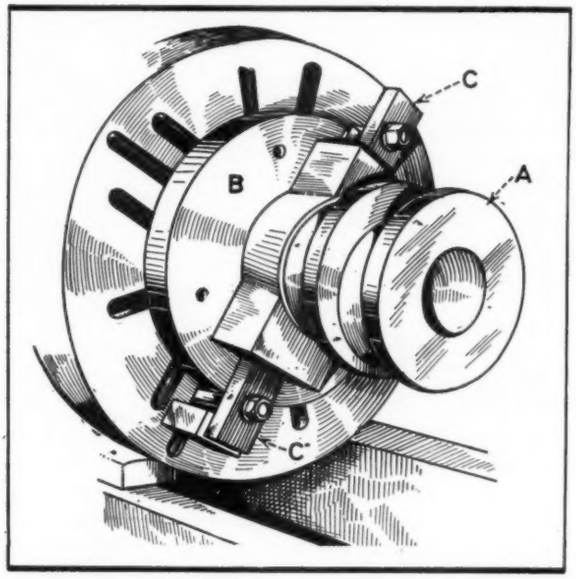
The clamping plate *B* bears against the rectangular corner of the toolbit and a 30-deg. wall on block *C*. Tightening the nut *D* brings enough pressure against the bit to make the arrangement nearly as rigid as a solid block. Holes in the clamping plate *B* and washer *E* are $\frac{1}{16}$ in. larger than the clamping screw so that when the screw is pulled down there is ample room for it to remain true with the threaded holes in block *C*.

We are using the toolbit clamp in the production of defense items. All risk of spoilage, due to toolbit movement on setscrews, has been eliminated.

Fixture For Offset Turning

BY FRED H. COLVIN

We had to make a number of pieces *A* on which several flanges had to be turned, a center hole bored, and an eccentric of the correct throw turned in line with the rectangular base. The false faceplate *B* was designed to hold the piece during all of these operations. The centering strip *C* is bolted parallel to this false facepalte. With the latter bolted to the



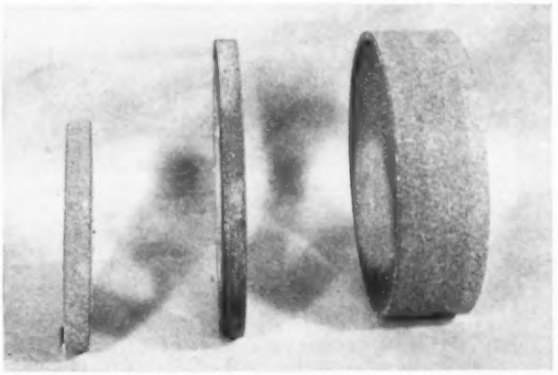
The forging is bolted to a centering piece mounted on a false faceplate. After turning the flanges and boring the hole, it is offset for turning the eccentric

lathe faceplate from the back, so as to leave its front surface clear, the work is located on the centering strip and clamped at each end as shown.

The work is first centered by the flanges for boring the hole, turning the flanges, and turning the neck between the inner flange and the base. Then the piece *A* is loosened enough to be moved endwise on the centering strip the right amount to give the desired throw, in which position it is clamped and the eccentric portion turned. For a similar piece in which the slot at the back is not in the center, another faceplate was made with the centering strip located at one side of the center the right amount for the offset desired.

Reclamation of Grinding Wheels

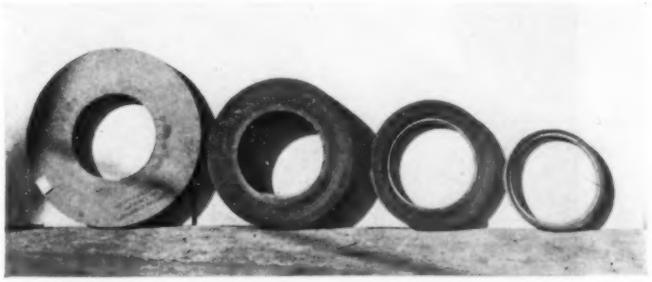
A study of grinding wheels by the Reclamation Department at the Caterpillar Tractor Company has led to new uses for wheels after they are taken off the machines for which they were originally purchased. By standardization of arbor holes, it is now possible to use the same wheel on as many as three different machines and still provide them with the



The cup wheel at the right is 12 in. diameter and 3½ in. wide. When the cup portion, of different bond and grain than the back, was worn, the back was used for a wheel 12 in. diameter and ¾ in. wide

grain size and bond that is needed on each particular job.

The work of recutting is done by outside contractors; wheels are recut to size, counterbored if necessary, and speed tested. By the changing of wheel designs, a system of progressing wheels from one machine to another without added alterations



This grinding wheel was originally 42 in. diameter and 3 in. wide. It was used to 36 in. diameter, recut to a narrower width and 30 in. diameter for a second machine. For a third machine, it was recut to a narrower width and discarded at 23 in.

has also been made possible. Wheels can now be used down to the boltter by increasing spindle speeds on a number of tool grinders; special steadyrests have been designed for the latter to get the maximum wear from the wheels without loss of wheel efficiency. In addition, abrasive disks are trimmed down to the next smaller standard size and put back to work as new ones.

Further development in grinding wheel reclamation has been a sectional bond wheel, by having one bond and grain size from the outside diameter down to the discarded diameter, and another grain size and bond from that diameter to the arbor hole. All that is necessary is the progressing of the wheel from one machine to the other.

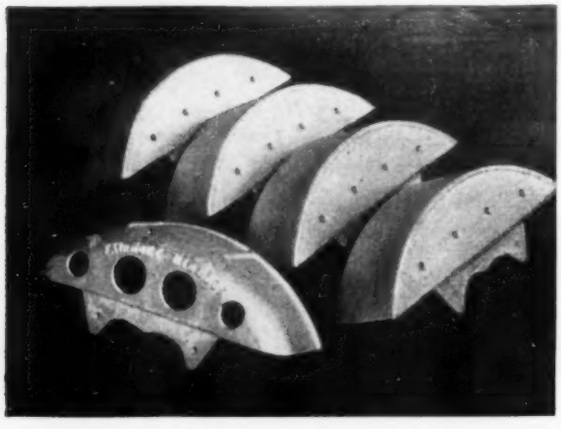
The standardization of hole sizes for wheels and the setting of correct spindle speeds relative to the wheel diameters are the two outstanding factors in Caterpillar's grinding wheel reclamation program. The examples given are typical of the success attained.

Steel Replaces Aluminum on Railroads

BY A. H. CARROLL

Railroad welders are today fabricating parts of motive power equipment from steel plate to replace those made of aluminum. Take the illustrated mud guards used on motor cars for example. These were made from flame-cut sheet steel in anticipation of an aluminum shortage as a result of the national defense program. The steel guards work equally as well as the aluminum ones; in fact, they are subject to less breakage.

In addition, we are now making motor-car water jackets from sheet steel, instead of purchasing those made of aluminum. In this instance, $\frac{3}{16}$-in. plate is rolled into a cylinder, suitable heads and bosses are applied, and the assembly welded with coated rod. Aluminum running boards on these cars are also being replaced with ones of sheet steel.



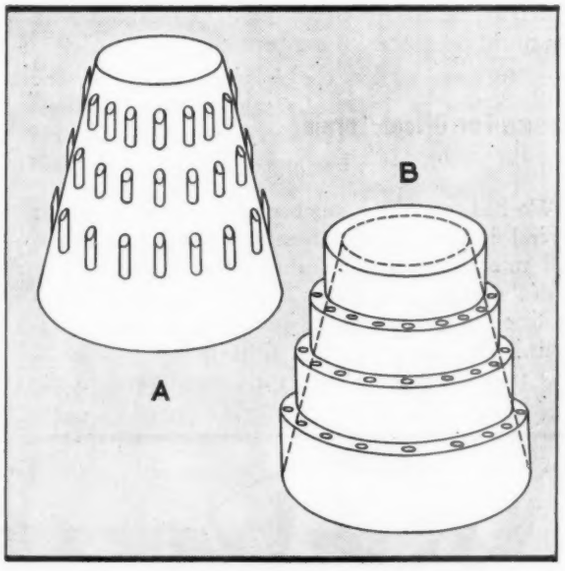
The railroad motor car mud guard in the foreground is made of aluminum. These are being replaced with all-welded sheet-steel guards, shown in the background

Holes Drilled in the Side of a Cone

BY FRANK C. HUDSON

The cone *A* with the rows of pins set vertically, or parallel with its axis, is the male part of a die for a plastic injection molding. Each of the many pins had to be lined up with the axis to draw out of the work after it was molded. And the finished cone gave no clue whatever as to how the holes for these pins were drilled.

How the work was done is shown at *B*, which shows a small stepped cone with shoulders spaced



The pins in the cone at the left are parallel to the cone axis. Holes for the pins were drilled vertically through terraces, which were later machined off, forming the cone

at the proper intervals. These shoulders were made just enough wider than the diameter of the hole to let the drill get a good "bite" in the metal so as to drill a straight hole.

Even with these flat surfaces to start the drill it is none too easy to space the holes properly and to drill them deep enough to hold the pins after the piece has been turned to a perfect cone, as in *A*. But it seems to be the only practical solution, since even with a good drill jig it would be very difficult to start a drill against the sloping side of the cone even under the most favorable conditions.

With the holes all drilled, the shoulders of the stepped piece *B* were turned off as shown by the dotted lines. Then the cone was ground, the pins driven in and their ends ground to the same angle as the sides of the cone. This made it possible to set this male cone into its mate, with perfectly smooth sides of the same angle, and leave the desired amount of space between the two cones for the plastic material. The pins, of course, acted as cores and make the cone into a strainer.

Armament

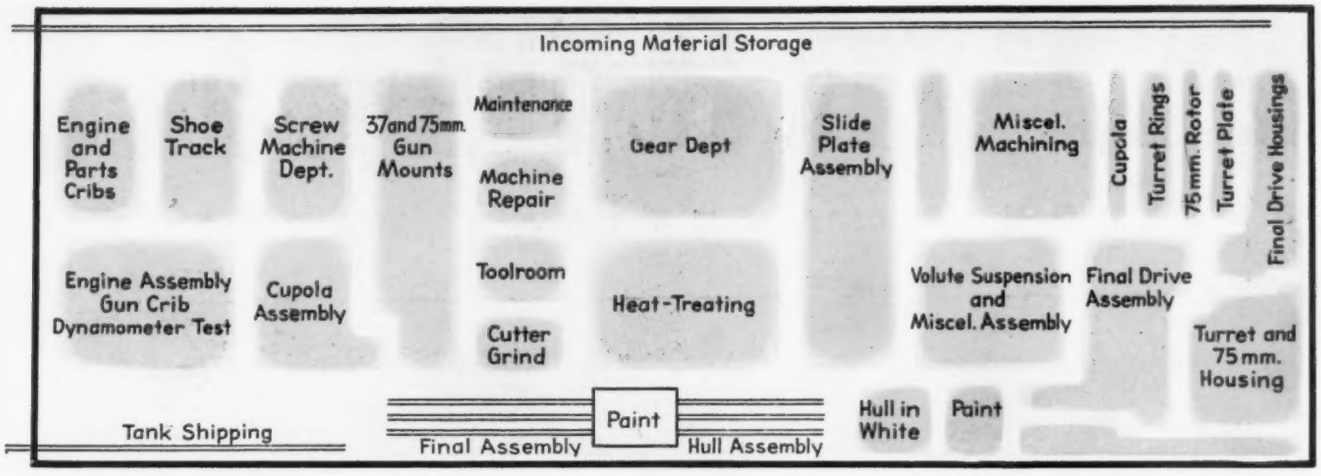
SECTION OF AMERICAN MACHINIST

Tanks Ahead of Schedule

NO PRECEDENT existed for laying out the U. S. Tank Arsenal to produce 28-ton tanks in mass-production quantities. From 1919–1935, ordnance engineers experimented with tanks only on a highly restricted basis because of lack of funds. In recent years, Rock Island Arsenal built a few medium tanks and developed satisfactory drawings. As a consequence, when the call came to build M-3 tanks in quantity, Chrysler Corporation could not draw upon a large pool of information directly related to many production problems.

The Tank Arsenal is analogous to an automobile plant in size and layout, but otherwise there are many differences. First, because the size of the product, and second, because of the quantities involved, major components are handled on production lines that consist of general-purpose machine tools—planers, boring mills, radial drills, milling machines and engine lathes—of a capacity associated with the building of heavy machinery and railroad equipment, not automobiles.

The basic processing methods developed by a large force of Chrysler master mechanics and tool engineers in late 1940 have proved sound in actual production.



The Arsenal now has a complete manufacturing organization staffed by experienced men. Even though thousands of detail problems had to be solved within a few months, and there was little past experience that could be drawn upon, output already is 50 percent ahead of schedule.

Two pilot tanks were constructed in the Corporation's plants to train the supervisory staff for the Arsenal and to develop data on machining methods. The Arsenal now has a complete manufacturing organization staffed by experienced men from Chrysler plants. It has been their job further to refine the details of tooling, including feeds and speeds, and operation sequence from lessons learned while actually turning out tank parts in quantity. This work has involved thousands of details, but the standardization of method has proceeded so rapidly that actual tank production is well ahead of schedule. Other Chrysler divisions are duplicating certain machining lines in accordance with a new program to enlarge the original production goal.

The Army's decision to employ armor-steel castings for the turret, the cupola, and the 75-mm. gun-mount housing on the M-3 tank transferred much of the work from tedious plate-fabricating methods to heavy machine shop work. These armor-steel castings weigh as much as 3,800 lb., and are designed with military requirements in view, not easy machining. Originally the castings were made with a ¼-in. stock allowance for machining, but to make sure that sound metal will be reached the allowance has been increased to ½ in. on many surfaces. This development caused revision of roughing tools.

Toughness and hardness of the castings dictated the use of carbide tips recessed into heavy forged tool shanks for most turning tools, although some cobalt high-speed tools are employed. With carbide tools, cuts are carried out at speeds up to 150 surface ft. per min., with a ½ in. depth of cut and a feed of 0.010–0.015 in. per rev.

Tool angles are subject to revision in order to attain maximum production and tool life. In general, heavy turning tools for armor-steel castings have a front clearance angle of 7 deg., a side rake of 15 deg. and a back rake of 7 to 8 deg. A negative top rake of 3 to 5 deg. is probably the desirable maximum. All carbide tools are honed.

The turret, a bowl-shaped armor-steel casting, over 5 ft. in diameter and weighing, in the rough, as much as a large automobile, exemplifies the need for general-purpose equipment on many tank components. This piece is handled on a production line with equipment consisting of boring mills with tables approaching 100 in. in diameter and huge radial drills.

The turret is set up on a milling machine fitted with a plain ram and a turret-type ram. Machining is carried out in seven distinct stages: (1) Face off the top to get rid of the scale, (2) Turn the outside and inside diameters for the same purpose, (3) With tools in right and left-hand heads, take three facing cuts approximately ½ in. deep up to both sides of the central contour, (4) Form half the top radius and establish the height of the radius, (5) Undercut the rim on the inside, (6) Form the flank of the contour and the gully, and blend the cut with half-radius produced in operation 4, and (7) Finish the outer face and chamfer into the gully.

Straight turning and facing operations are carried out at speeds up 150 ft. per min. and 0.015 in. per rev. feed, but for the radiusing and contouring operations the speed is reduced to 125 ft. per min.

A number of contour milling operations are required in connection with cast armor-steel components for medium tanks. Typical of the longer set-ups is that of milling the two-step contour on the

Seven operations, involving the use of tools in both the right- and left-hand heads of the boring mill, are required to machine the lower rim of the turret

TIMETABLE OF AN ARSENAL

1940

June 9—Defense Commissioner Knudsen asked Chrysler President K. T. Keller, "Will you make tanks?"

June 15—July 22—197 production experts study blueprints, construct wooden mock-up of the tank.

August 15—Chrysler Corporation receives a government contract to build and equip a $20,000,000 tank arsenal.

September 18—Tentative layouts for arsenal are ready.

September through December—200 tool designers develop processing methods, specify 1,000 machine tools, 8,000 tools and gages.

1941

January 18—First heavy machinery arrives.

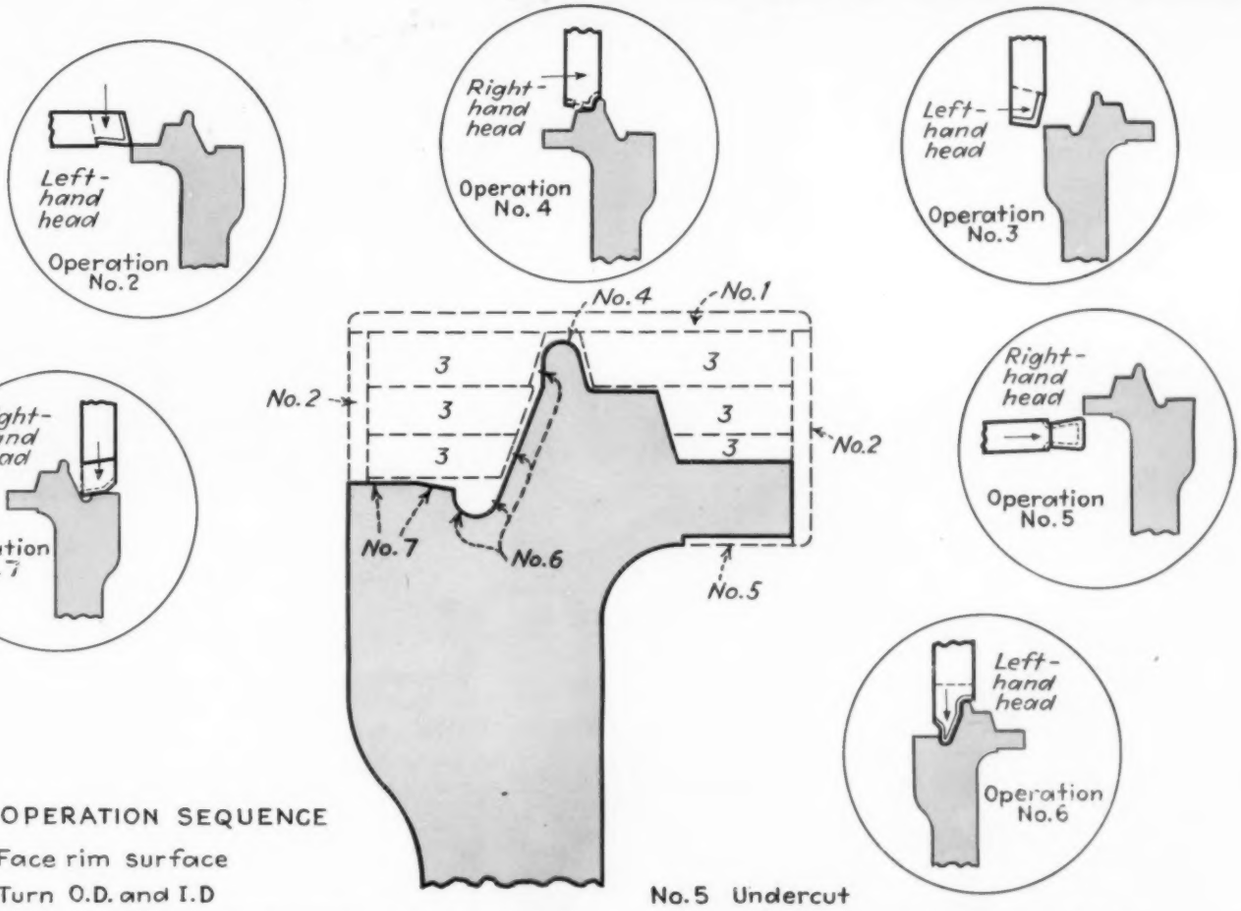
February 12—First production castings arrive.

April 17—Some machinery in operation.

August—Mass production begins.

December—Output 50 percent ahead of schedule. Steps being taken to double original maximum capacity.

Machining the lower rim on the cast armor-steel turret is performed at cutting speeds up to 150 ft. per min. with carbide tools



OPERATION SEQUENCE

No. 1 Face rim surface

No. 2 Turn O.D. and I.D

No. 3 Face to contour - 3 cuts with R. & L. hand heads

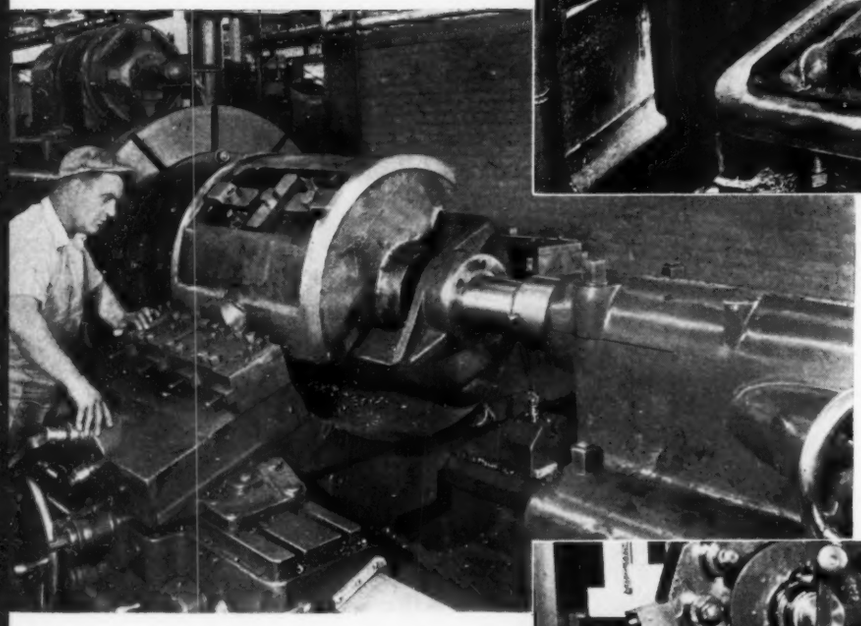
No. 4 Form radius

No. 5 Undercut

No. 6 Form flank of contour and gully

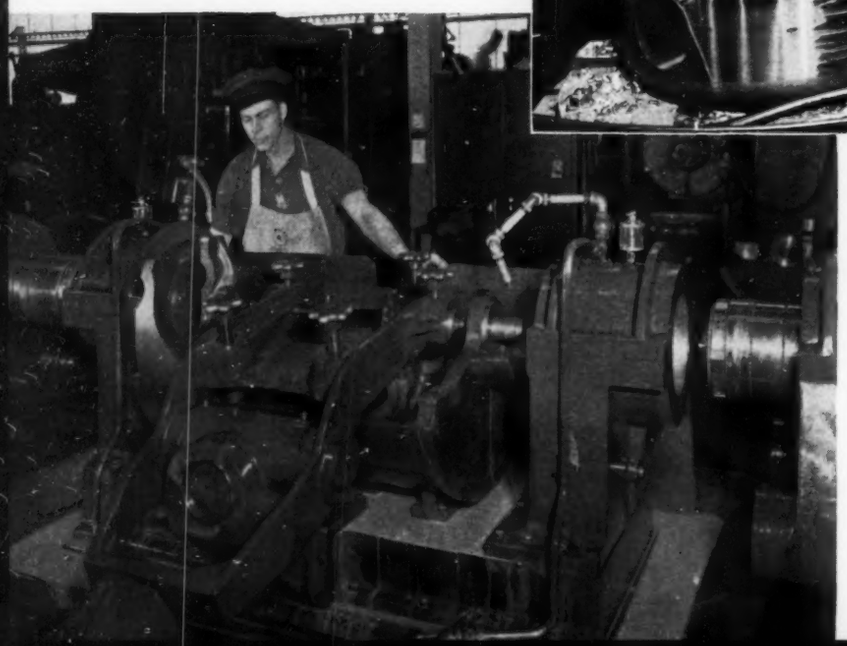
No. 7 Finish face and chamfer into gully

Only two cuts are now required to contour mill the two steps on the cast-armor front turret plate



The cast armor-steel rotor for the 75-mm. gun mount is machined at 165 surface ft. per min., 0.014-in. feed per rev. and up to 1/2-in. depth of cut

To form the 2 1/2-in. radius on the shield for the 75-mm. gun, three cuts are taken. Two turret toolblocks rough at least 1/2 in. of metal, some 3/4 in., and the single carbide tool in the side head shaves the radius



To machine the trunnions on the rotor for the 75-mm. gun mount, the piece is placed in a double-end machine having two single-spindle heads. Eight cutter changes are made on each spindle

periphery of the front turret plate. This job, which is handled on a miller, involves two operations on the bearing caps, as well as contour milling.

The two steps on the periphery are now milled in one cut each, whereas originally it was deemed necessary to take roughing and finishing cuts. One cut, despite a depth averaging ½ in., will hold the desired limit of 0.010 in. The Arsenal has learned that a slow speed and heavy feed are best in milling cast armor steel. On this job 4×7 in. inserted-blade cutter runs at 52 r.p.m. and the feed is between 1½ and 2 in. per min.

The machining of the cast armor-steel rotor for the 75-mm. gun mount involves many problems in tool and machine development. In effect, the piece is a semi-circular shield with an opening in the middle for the gun shield, cross bores to hold the gun cradle and trunnions at top and bottom to take the weight of the gun and mount. Trunnions and cross bores must be machined square with each other and to exceptionally close limits.

The interrupted surface of the rotor and the semi-circular end faces are turned on a 48×84 engine lathe. A number of changes in tools and fixture have increased the permissible turning speed to 165 surface ft. per min., with a feed of 0.014 in. per rev. and a depth of cut ranging from ¼ to ½ in. All but a few thousandths are removed in the roughing cut. Tool shanks have been progressively increased in size, are now 1×2 in. to provide adequate support for the cemented-carbide tips, and to attain greater rigidity. The usual front toolblock has been superseded by a special inclined block carrying four tools at 8-in. centers. Tools are placed at staggered levels so that only one hits the work at a time.

To steady the work in a better manner, it is now centered before being mounted in the fixture, and centers are added to the set up to hold the piece. By centering the piece before turning, excess metal is thrown to the outside and removed on the lathe. This practice has saved considerable trouble in subsequent operations. Additional supports in the fixture back up the work behind the rectangular gun-shield opening.

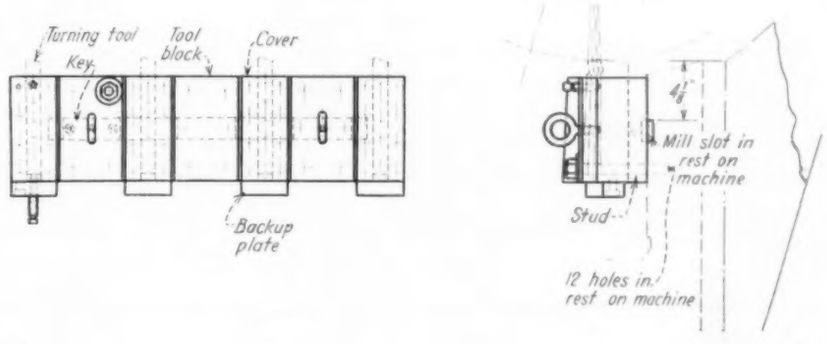
The cross bores and the trunnions are machined in four double-end machines of similar design. Operations are split up into roughing and finishing cuts on these machines because each set-up involves a number of successive tool changes on the spindles.

The finish machining operation on the trunnions is indicative of the types of tools employed and the quality of fixtures required to hold a bulky heavy piece of rapidly changing cross-section and springy characteristics. The job involves: (1) Hollow mill the trunnions, (2) Turn and face a shoulder, (3) Bore a half-round surface below the trunnion and concentric with it. Limits indicate the nature of operation (1): over-all distance between faces of trunnions +0.000, —0.005 in.; diameters of trunnions, +0.000 —0.001 in. Because extra stock has been allowed at the trunnions, to achieve sound metal, roughing and finishing cuts are required.

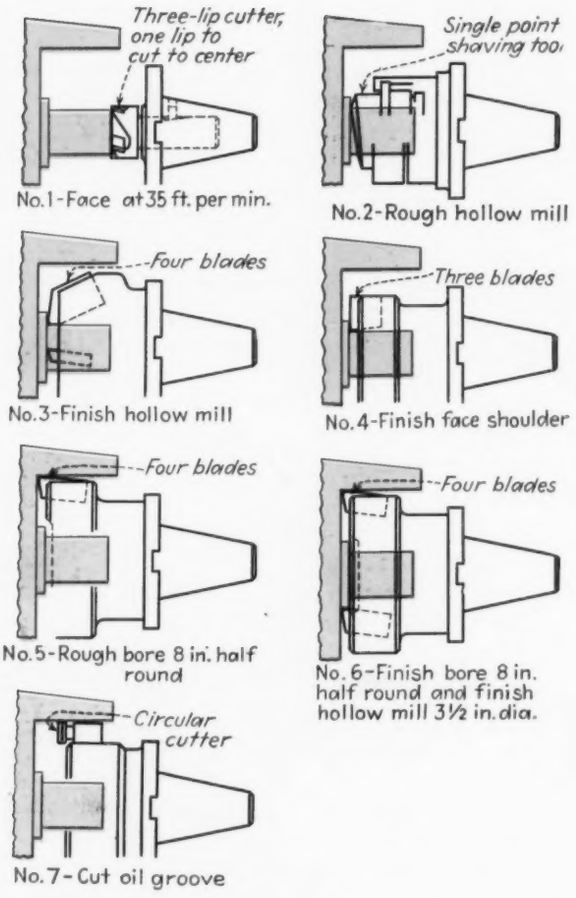
The double-end machine has way-type platens, each of which carries a single-spindle head. Tools are interchangeably mounted on the spindle end face, are ground in the toolroom to a definite gage length from the mounting face. A tool on one spindle is changed by the operator while the opposite spindle is working. Spindles are individually controlled by push-buttons.

Because of the variation in the diameters machined (from 2⅛ to 8 in.) it was necessary to provide a two-speed spindle drive affording 62 and 125 r.p.m. Therefore, tools operate at speeds between 35 and 130 surface ft. per min. The feed rate is constant: 0.004 in. per min. Cobalt high-speed steel tools are employed for roughing cuts, and carbide tipped tools for the finishing cuts. Carbide tools have not been satisfactory on some of the internal cuts. In consequence, high-speed steel tools have been substituted and the speed reduced. Turning tools in current use average a 7 deg. back slope and a 4 deg. clearance angle. Facing tools have integral chip breakers, are set well ahead of center to obtain a skiving or shaving action.

The fixture has a counterweighted clamping leaf to permit loading the 900-lb. piece from the top. Height location of the piece is taken by four ground



A special low-slung toolblock carries four 1 × 2 in. tipped tools at staggered levels for turning interrupted surfaces on the rotor for the 75-mm. gun mount


Three-lip cutter, one lip to cut to center
No. 1 - Face at 35 ft. per min.
Single point shaving tool
No. 2 - Rough hollow mill
Four blades
No. 3 - Finish hollow mill
Three blades
No. 4 - Finish face shoulder
Four blades
No. 5 - Rough bore 8 in. half round
Four blades
No. 6 - Finish bore 8 in. half round and finish hollow mill 3½ in. dia.
Circular cutter
No. 7 - Cut oil groove

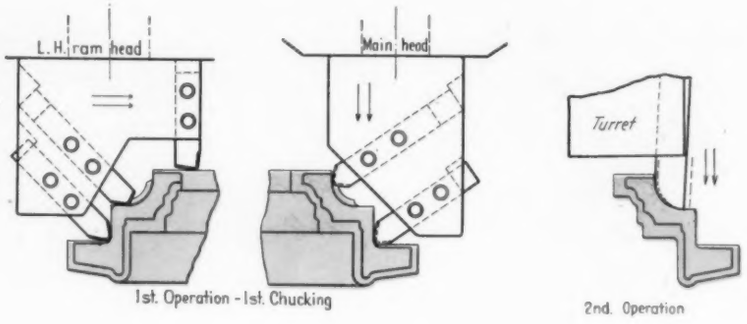
Tool layout for machining the trunnions on the rotor

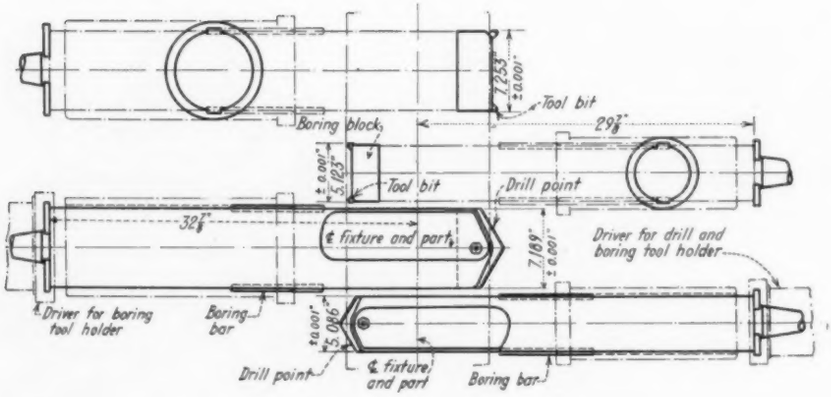
pads bearing against the ground gun-shield opening in the rotor. The finished bores are picked up by rack-operated plugs to establish squareness and end location of the piece. Independent jackscrews in the fixture back up the trunnion sections of the rotor to prevent the work springing because of the cutting pressure.

Operations on each of the rotors are practically identical. They include: (1) Face end of trunnion with a three-lip cutter, one lip cutting to the center; (2) Rough hollow mill the 2⅛-in. trunnion diameter with a single-point high-speed steel shaving tool; (3) Finish hollow mill the trunnion outside diameter with a four-blade cutter; (4) Face the 5-in. diameter with a three-blade face mill; (5) Rough bore the 8-in. half-round diameter below the trunnion with a four-blade cutter; 6) Finish bore the half-round diameter and hollow mill the 5-in. diameter; (7) Cut an oil groove with a circular form tool held in a toolblock; and (8) Re-use tool from operation 6 to remove the burr thrown up in grooving.

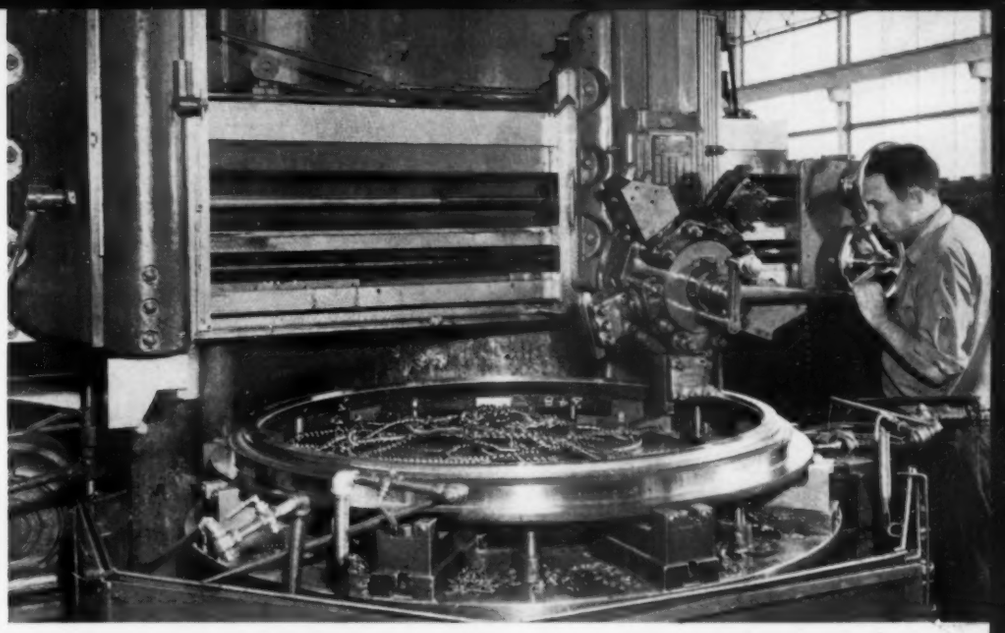
Machining operations on the cast-armor shield for the 75-mm. gun are chiefly carried out on general-purpose equipment, such as planers and a number of vertical turret lathes. One of the most unusual cuts on the latter equipment involves the shaving of a 2½-in. radius with a carbide tool. The shield is a semi-circular casting, which is laid flat on the table for the following sequence of operations: (1) Rough and finish turn the outside diameter with a single carbide tool; (2) Rough and semi-finish the bore,

A partial tool layout discloses that five tools are employed to rough the upper surface of the lower race ring. Cutting speeds are high: 150 ft. per min. for roughing; 225 ft. per min. for finishing

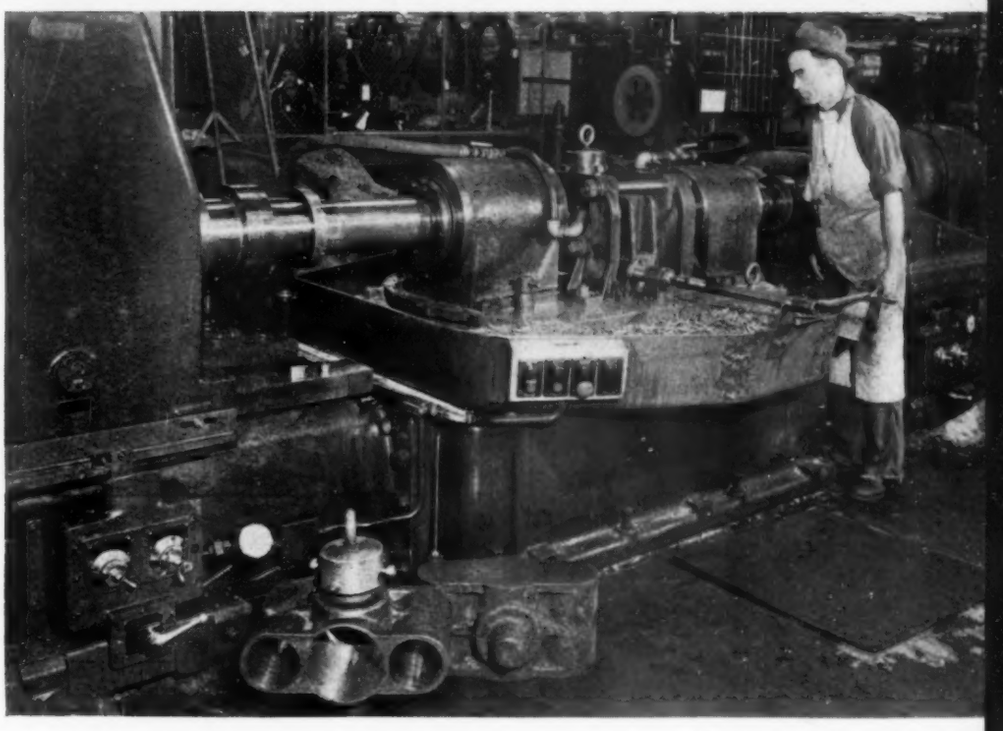




Special drill bits and boring-tool holders are interchangeable in the slotted spindles of this machine



At the first operation, several surfaces, including the ball radius, are turned on the lower race ring for the turret. Because of the ring's size, over 5 ft. in diameter, the operation is carried out on a 64-in. vertical boring mill carrying nine carbide tools in five toolheads



Hydraulic feed is applied to the spindles of this double-end machine to minimize tool breakage, when drilling and boring three large holes through the trunnion block for the 75-mm. gun cradle assembly. Development of the forging art is still going on to improve machinability of this 400-lb. piece

the bearing caps being assembled in place; (3) Counterbore the upper cap; (4) Form the 2½-in. radius; and (5) Ream the 7-in. bore. Rough turning operations are carried out at 70 ft. per min. with a 0.011 in. feed per rev. The depth of the rough cut may reach ¾ in. at points; it usually runs ½ in. Only a few thousandths are left for finishing.

Forming the radius is done in three stages. One toolblock on the ram turret is fitted with eight high-speed steel bits and is fed into the radius to hog out metal and leave ridges. These ridges are reduced by a second turret position. Shaving the remaining stock —0.010 to 0.020 in.—is accomplished with a single carbide tool held by the side head to catch the entire radius and blend it with the finish-turned face and outside diameter of the piece. Hand feed is of necessity employed on this operation, and the speed is cut down to 30 ft. per min.

Forgings dealt with in tank manufacture often require removal of considerable stock in the machining operations. These parts are made of tough, heavily alloyed steel approaching 300 Brinell in the annealed condition.

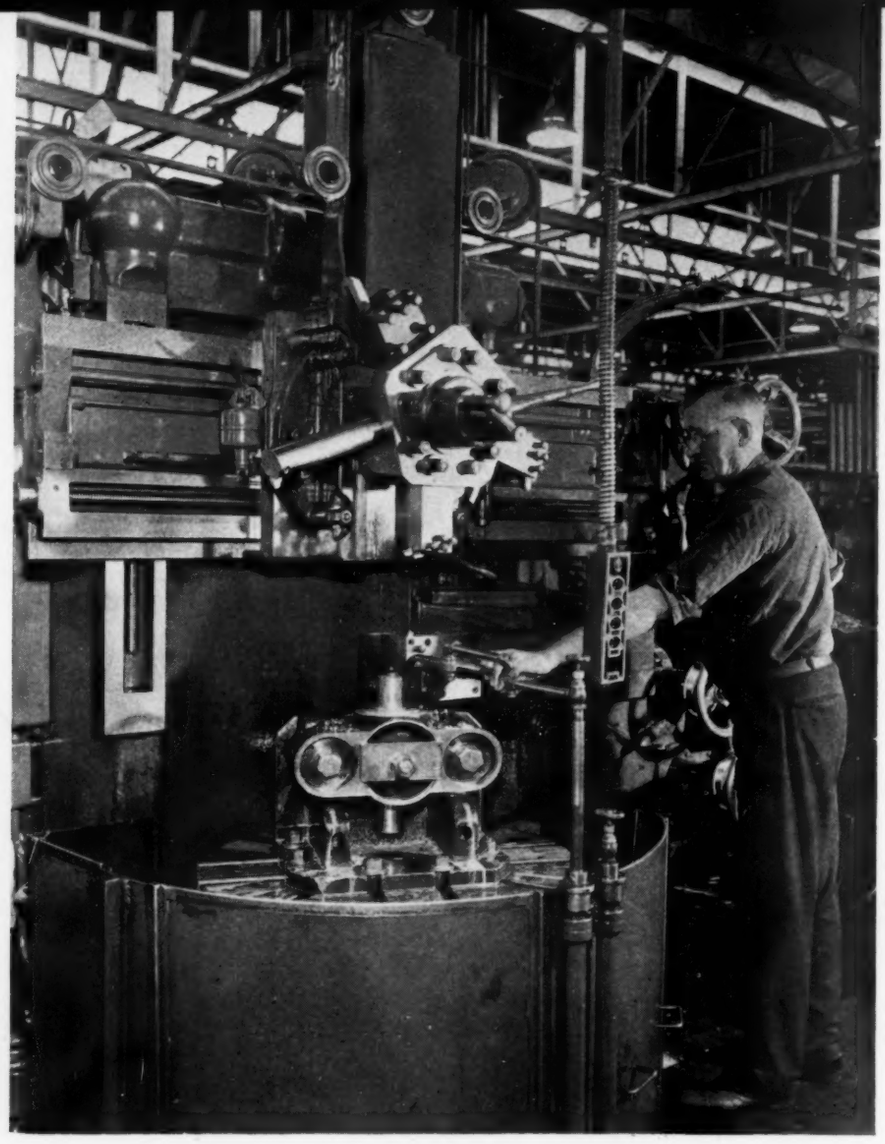
Race rings and retainers for the main-turret bearing must be handled largely on general-purpose machines of large size. The lower race, for example, is machined on the upper and lower surfaces on 64-in. vertical mills fitted with two rail heads, one a plain ram and the other a turret type. Side heads are also required to machine the lower portion of the ring.

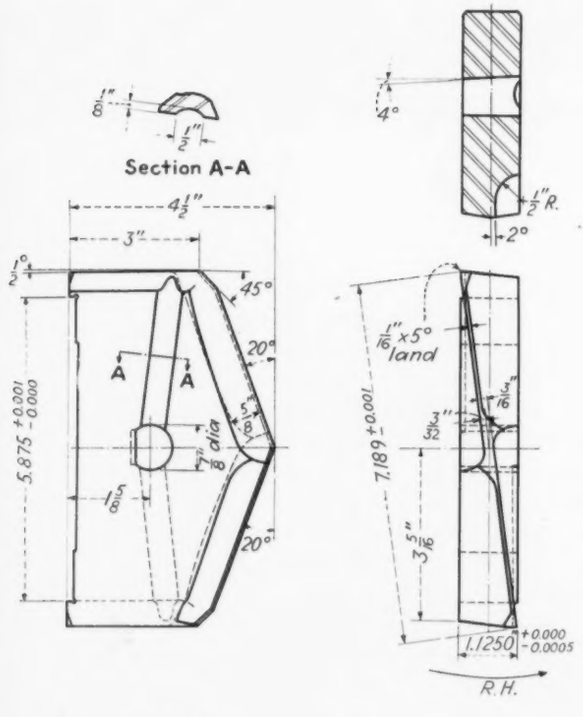
The first operation on the lower race ring involves turning the upper part with nine carbide tools.

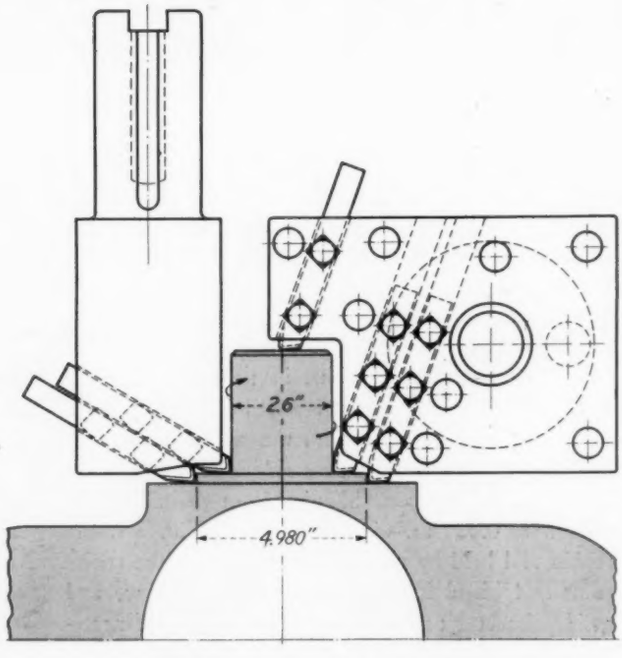
Experienced men from Chrysler plants are employed to operate the large number of general-purpose machines required. Here the operator is machining the trunnions on the trunnion block for the 75-mm. gun-cradle assembly

(Right, below) Multiple toolbits are fitted to holders on the side head and ram turret to maintain relationship of trunnion surfaces

(Below) A 140-deg. point angle and a 1/16-in. land are used on the two-lip drills for machining the three holes in the trunnion block forging







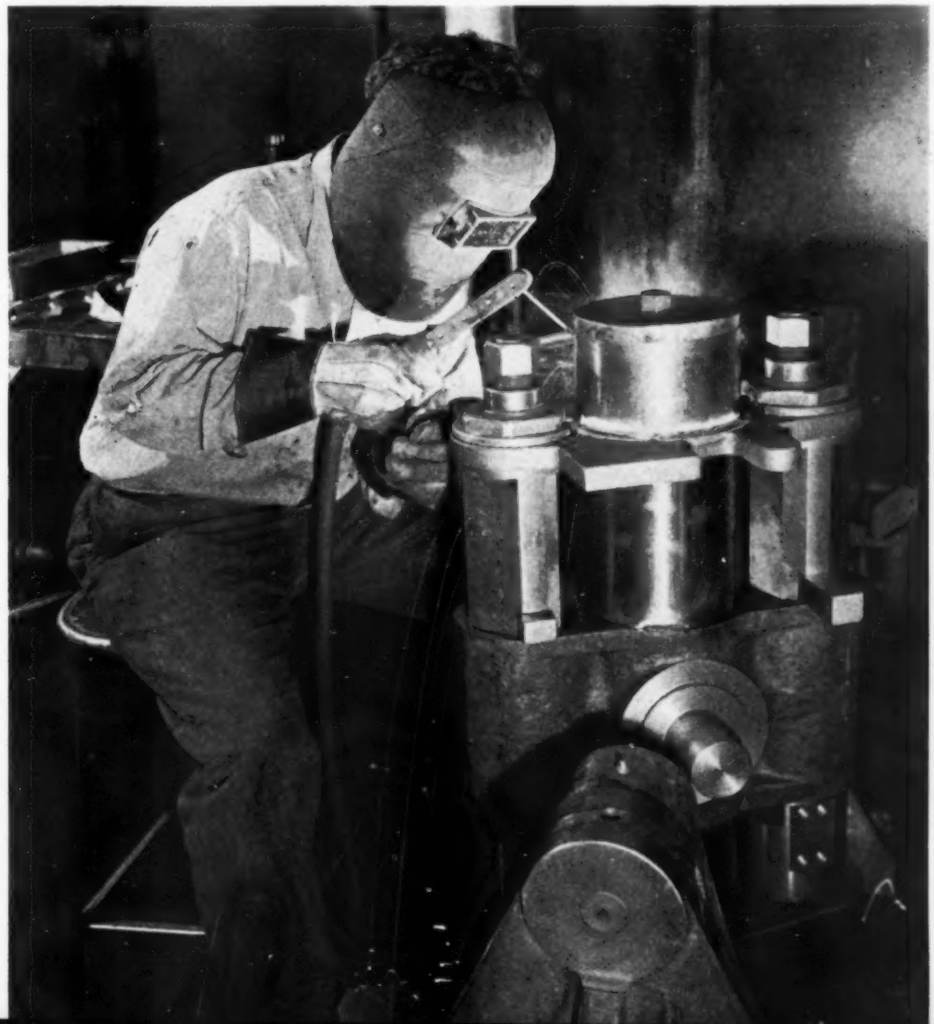
Operators use heavy roughing cuts, leaving only a few thousandths for finishing. Roughing is carried out at 150 ft. per min., with a feed of at least 0.010 and often 0.015 in. per rev. Finishing is speeded up to 225 ft. per min. to obtain the smooth surface possible with honed carbide tools. A speed of 100 ft. per min. is employed, however, for turning the radius for the ball bearings. This ring Brinells in the 256–285 range, usually toward the high side. Succeeding operations, such as turning the lower side and drilling 79 holes in two operations, involves the use of fixtures and taking location to bring the springy hoop-like ring back within 0.005 in. run-out on a 62 in. diameter.

The trunnion block for the 75-mm. gun cradle assembly is another unusual forging. This part weighs 400 lb. in the rough, only 100 lb. when finish machined. The principal metal loss occurs when drilling and boring the three holes through the part —the central 7¼-in. hole for the gun-liner bearings and the two 5⅛-in. holes for the two recoil cylinders. These holes are 10 1/16 in. deep. Hydraulic feed is employed to minimize tool breakage.

The trunnion block comes to a double-end machine with the top and bottom surfaces milled for a snug fit in the box fixture. The left-hand spindle drills and bores the main hole, and the two right-hand spindles take care of the recoil-cylinder holes. An 8-percent cobalt high-speed steel seems the most satisfactory material for the special two-lip drill bits. These bits are interchangeable in the spindles with the boring toolholders, which have two toolbits and which are used after the drills.

Side-head and ram-turret tools are employed on a vertical boring mill for machining the trunnions. Operations include: (1) Rough face trunnion end and two shoulders with the side head, (2) Rough turn the trunnion outside diameter and the step with the first turret tool, (3) Finish face the trunnion end and the two shoulders with the side head, (4) Finish turn the outside diameter of trunnion and step, and (5) Chamfer. Molybdenum high-speed steel tools are used for these operations.

The machined trunnion block is combined with four other parts and two welded subassemblies to form the 75-mm. gun cradle assembly. These components are located on an accurate fixture and tackwelded together. One man does all the tackwelding, and all the finish welding that can be reached with the fixture upright. A second man bench welds the subassemblies, and a third finishes the welding on the lower side of the gun cradle. Stainless steel elec-



After assembling the components of the 75-mm. gun cradle upon a tilting fixture, the operator tack welds the parts together and welds the joints between gun-liner tube and trunnion block with stainless-steel electrode

trodes are employed for joining the trunnion block and center tube.

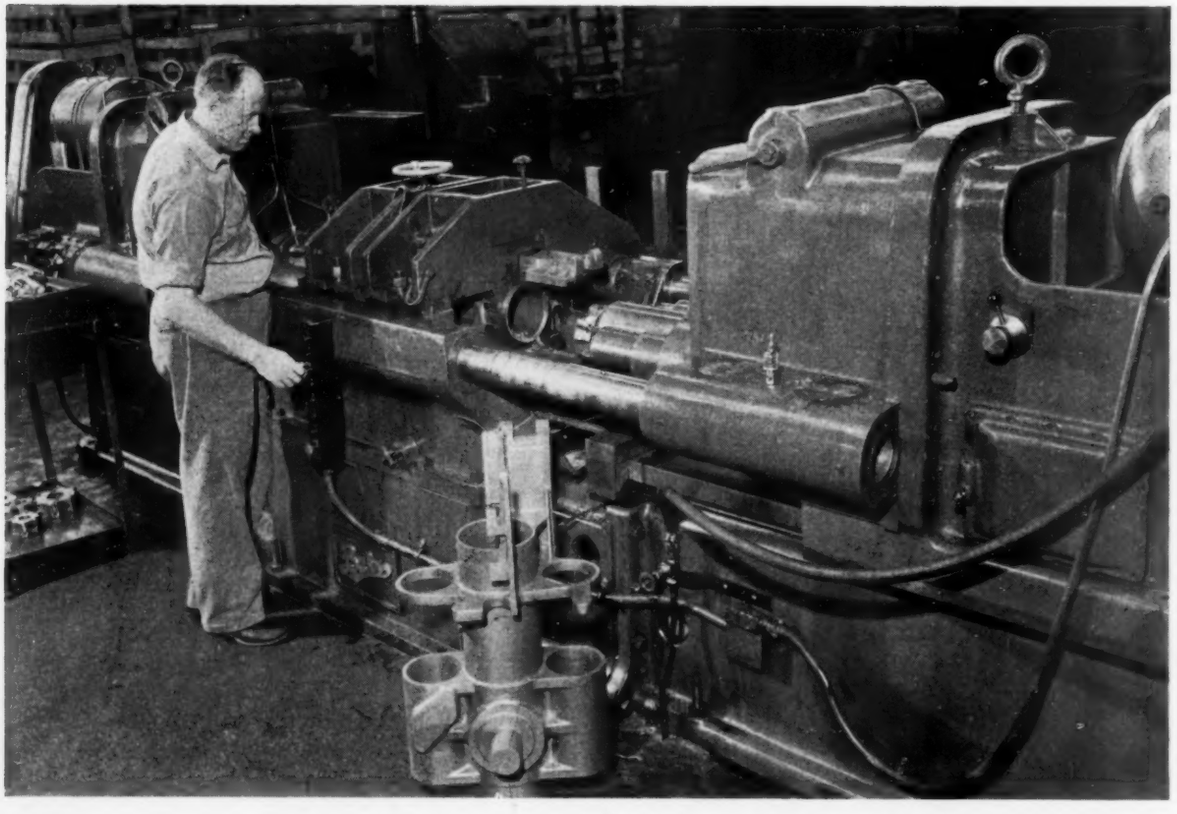
The 75-mm. gun cradles assembly is bored after welding in a double-end machine with three spindles at each end. At one end, the spindles travel 10 in. into the work to bore the recoil-cylinder holes in the trunnion block and a seat for a bronze bushing at one end of the gun-liner tube. At the opposite end the spindles travel a like distance to produce the other bearing seat and to bore the two holes in the supporting bracket for the gun-recoil cylinders. This set-up assures that the two bearings will be in close alignment and require only a light finishing cut in an engine lathe.

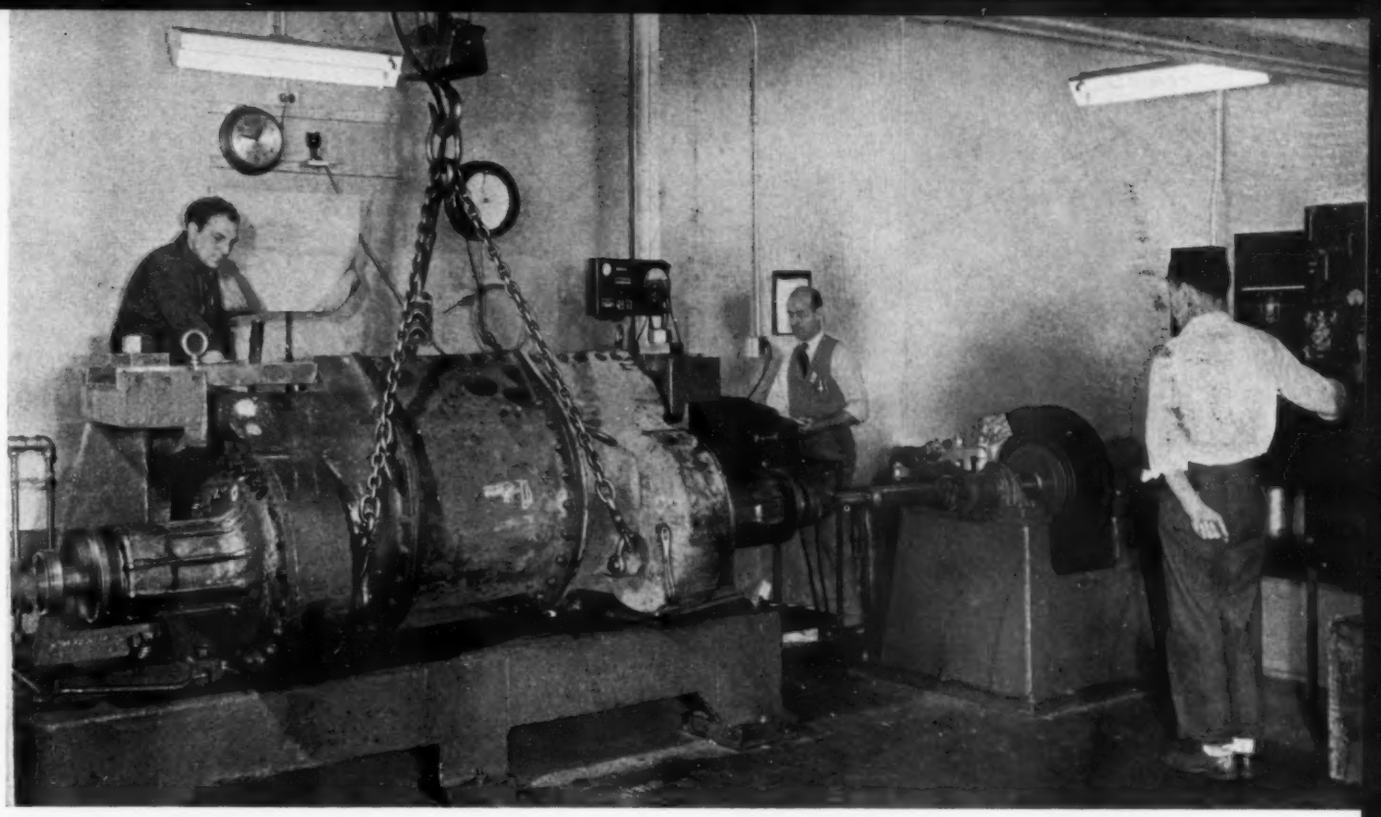
The holes are rough bored to 4.985 in., 5.235 in., and 6.860 in., and are finish bored to 5.000 in., 5.250 in. and 6.875 in., respectively. This leaves 0.015 in. on the diameter for the finishing tools to remove. The 5-in. and 5¼-in. tools are run at 41 r.p.m. for roughing and 28 r.p.m. for finishing. The 6⅞-in. tools are run at 40 r.p.m for roughing and 27 r.p.m. for finishing. The change from the one speed to the other is obtained by means of a quick-change feature built into the multiple heads. Hydraulic feed may be set from ¼ to 15 in. per min. but for this job the heads travel 10 in. in 25 min. Roughing tools have a single inserted blade; the finishing tools have six blades.

Gear manufacture is of outstanding importance in tank production for two chief reasons: (1) The number of different gears that must be processed and (2) Size, material and quality standards for many tank gears have no counterpart in automobile or truck production, and it has been necessary to establish processing methods in the light of previous experience and then make corrections as the need arises.

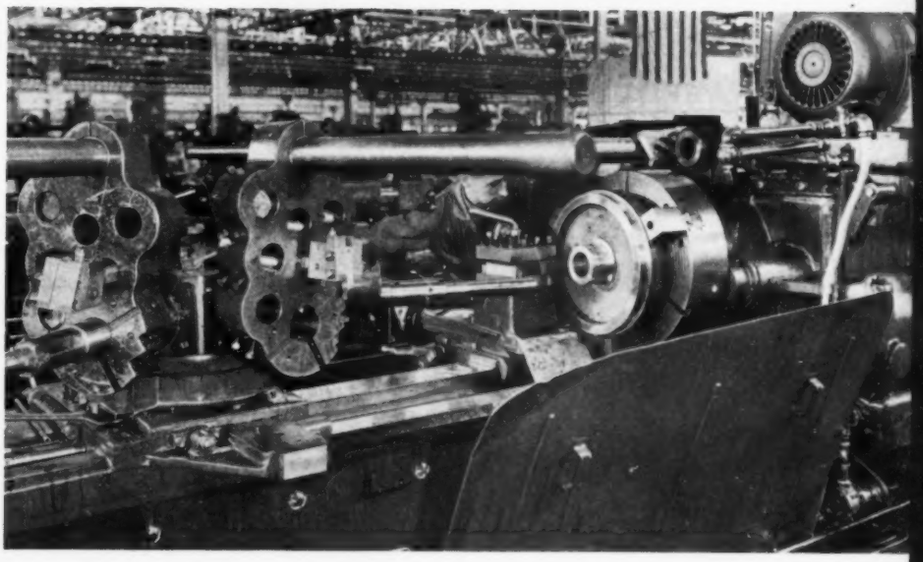
At the U. S. Tank Arsenal, gear cutting takes up as much space as several other major machining departments combined. When heat-treating and assembly facilities are added, it is seen that operations having to do with gears become of paramount importance. At least 31 different jobs involving gear cutting must be handled in the department, some on a batch basis, others as production set-ups because of the length of time required on the operations involved. Practically all gears are cut from SAE 4820 steel forgings. None are ground after heat-treatment. Tooth correction is limited to shaving before car-

Rough and finish boring the gun-recoil cylinder bores and the gun-liner tube are performed on a double-end machine. The tube is bored 10 in. deep at each end to receive bronze bearings for the gun liner

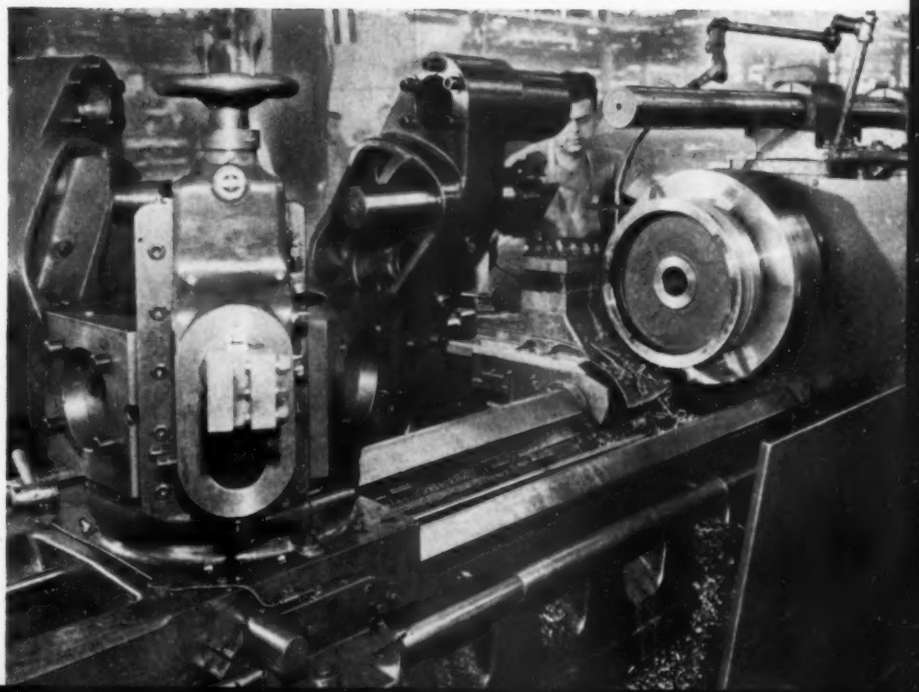




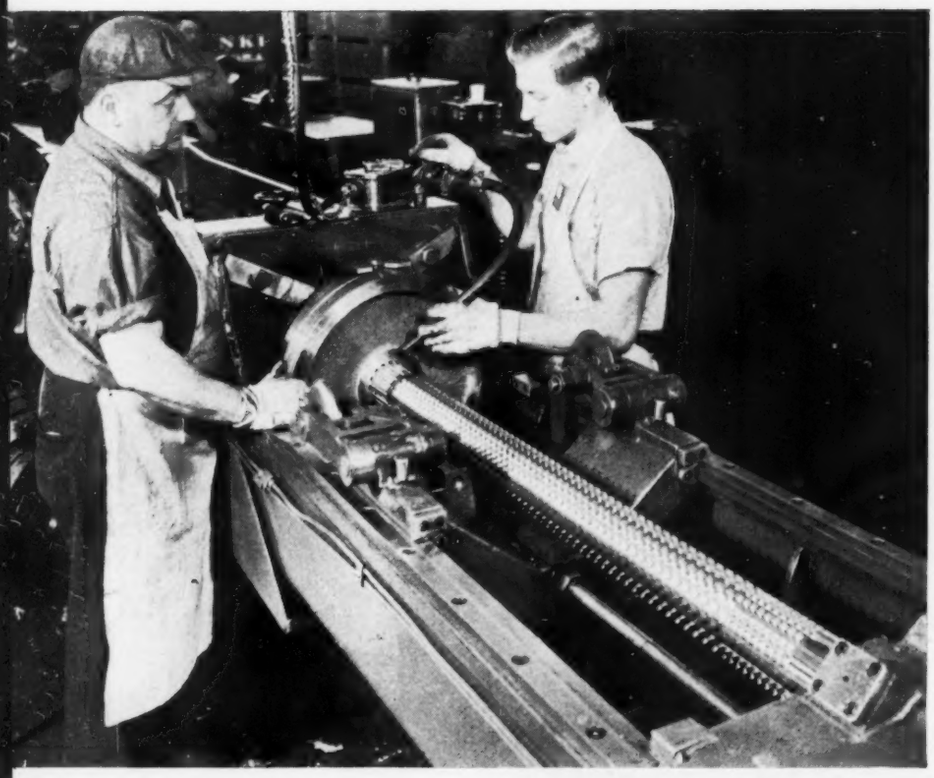
Gears, cluster shafts and synchronizing elements for the final drive assembly, which weighs approximately four tons, are the chief product of the Arsenal's extensive gear-cutting department. Here the final drive is undergoing tests in the "noise house", an elaboration of automotive practice



First step in machining the herringbone final-drive gear, a principal component of the final-drive assembly, is carried out on a turret lathe. The rim is turned up to the chuck jaws, rim and hub are faced, the hub outside diameter is turned, and the hole drilled and bored

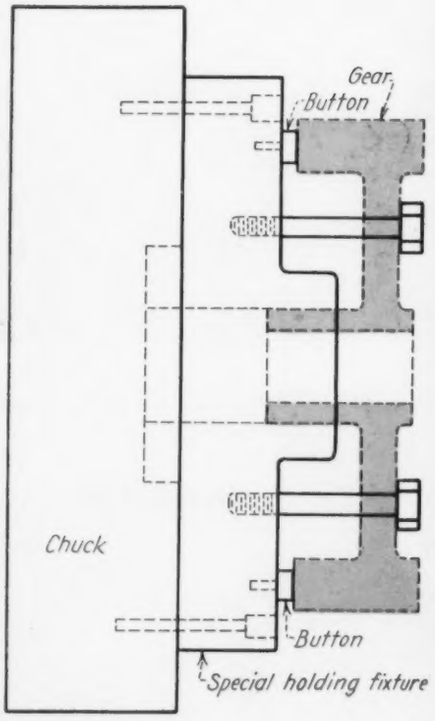


After chucking on the finished portion of the rim, the opposite side of the herringbone gear is machined on a turret lathe and the groove at the center of the rim is cut

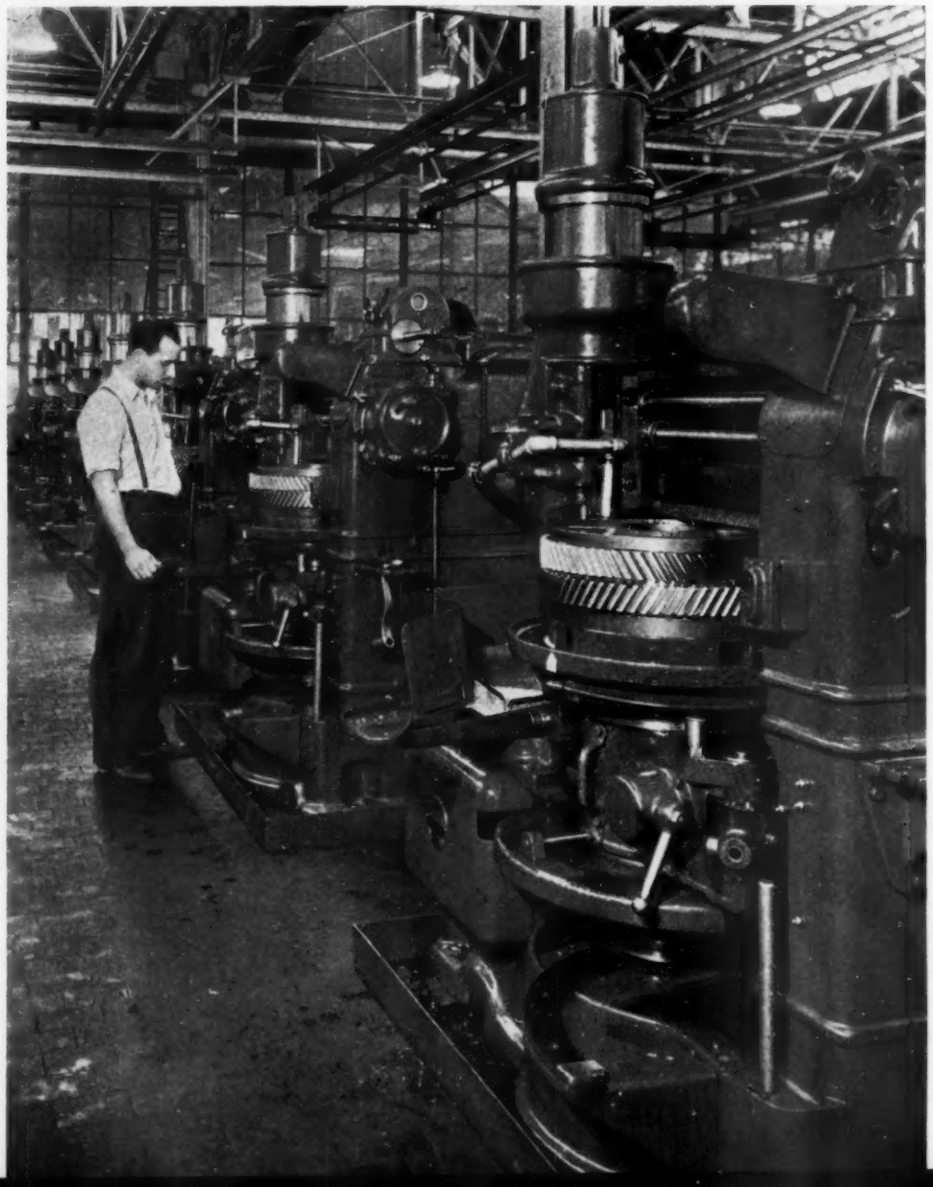


Spline broaching the bore in the herringbone gear is carried out in two steps on a pull-broaching machine, which is also employed for broaching other large gears and tank members

Two lines of gear shapers cut the teeth in right- and left-hand final drive gears respectively. The teeth on each gear are rough and semi-finish cut leaving stock for shaving



For green grinding the bore in the final-drive gear, the part is bolted to a special adapter, with the rim taking location from three buttons



burizing and occasional lapping afterwards to reduce high spots that may cause noise. The problems attendent upon producing high-quality gears to exacting dimensional and noise standards are complicated by the unusual cross-sections of many of the larger gears. Webs assume peculiar shapes, hubs may be considerably offset from the line of roll so distortion must be watched carefully.

The gear-cutting department must cut small bevel-gears integral with shafts for gun-elevating purposes, conventional spur gears, spiral bevel gears 20 in. in diameter, heavy herringbone gears, internal gears up to 5 ft. in diameter and numerous cluster gears. Many of these gears and shafts weigh over 100 lb., must be lifted into and taken out of machines by overhead hoists equipped with special self-locking slings. In fact, the final drive shaft having a spur gear cut at one end and a bolting flange at the other weighs 350 lb.

The final drive gear—a herringbone—is made in rights and lefts for driving the tracks on the opposite sides of the tank. Details of this gear are: material, SAE 4820; pitch diameter, 17¾ in.; number of teeth, 71; pitch, 4; face width, 4¼ in.; permissible backlash, 0.010 to 0.016 in. when meshed at 12 in. centers with mating gear; offset hub, 5 in. wide and broached with sixteen splines on a 3.5 in. pitch diameter.

Principal operations in the processing set-up follow:

First operation—Chuck on gear diameter in a turret lathe with the hub side out. The operation sequence on this machine is:

(a) No. 1 turret position—Drill 3-in. hole in hub, also rough turn the outside diameter up to the chuck jaws using the toolpost. In addition, rough face the rim and hub with toolpost tools.

(b) No. 2 turret position—Rough turn the hub outside diameter and rough bore the hub, using a multiple turning head and overhead pilot support.

(c) No. 3 turret position—Finish turn hub outside diameter for a short distance.

(d) No. 4 turret position—Finish bore the hub, leaving 0.012–0.015 in. for a green grind of the bore.

(e) Chamfer rim outside diameter and hub outside and inside diameters with toolpost.

High-speed tools are used for the roughing cuts; carbide tools for finishing.

Second Operation—Chuck finished outside diameter of gear on a turret lathe. The operation sequence on this machine is as follows:

(a) No. 2 turret position—Rough turn outside diameter. With toolblock, rough and finish face the rim and hub. Chamfer inside of rim.

(b) No. 3 turret position—Semi-finish turn the outside diameter. Form ⅜ in. groove at center of rim with toolpost.

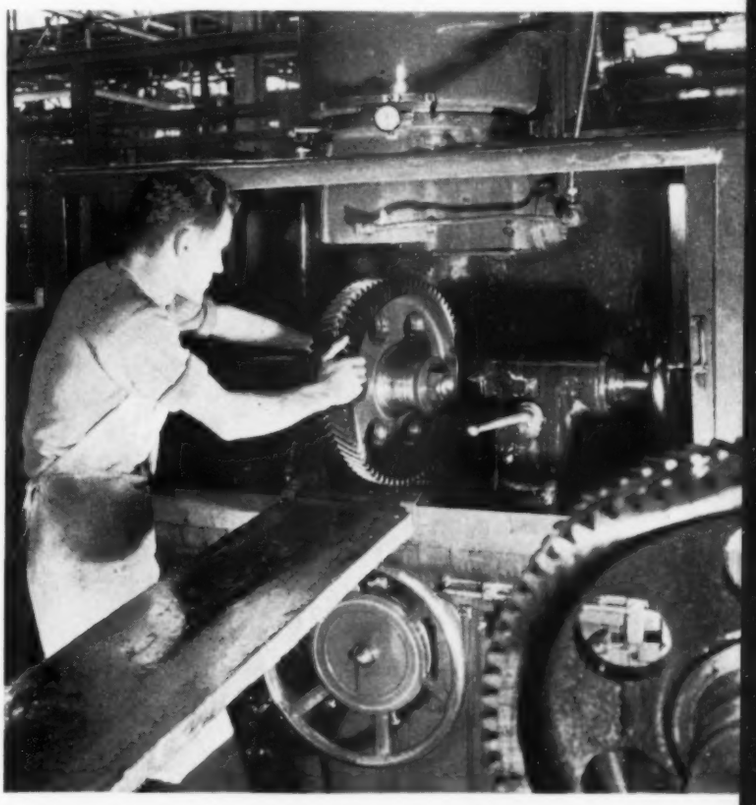
Third Operation—Drill web holes.

Fourth Operation—Broach the splines in two passes on an horizontal broaching machine.

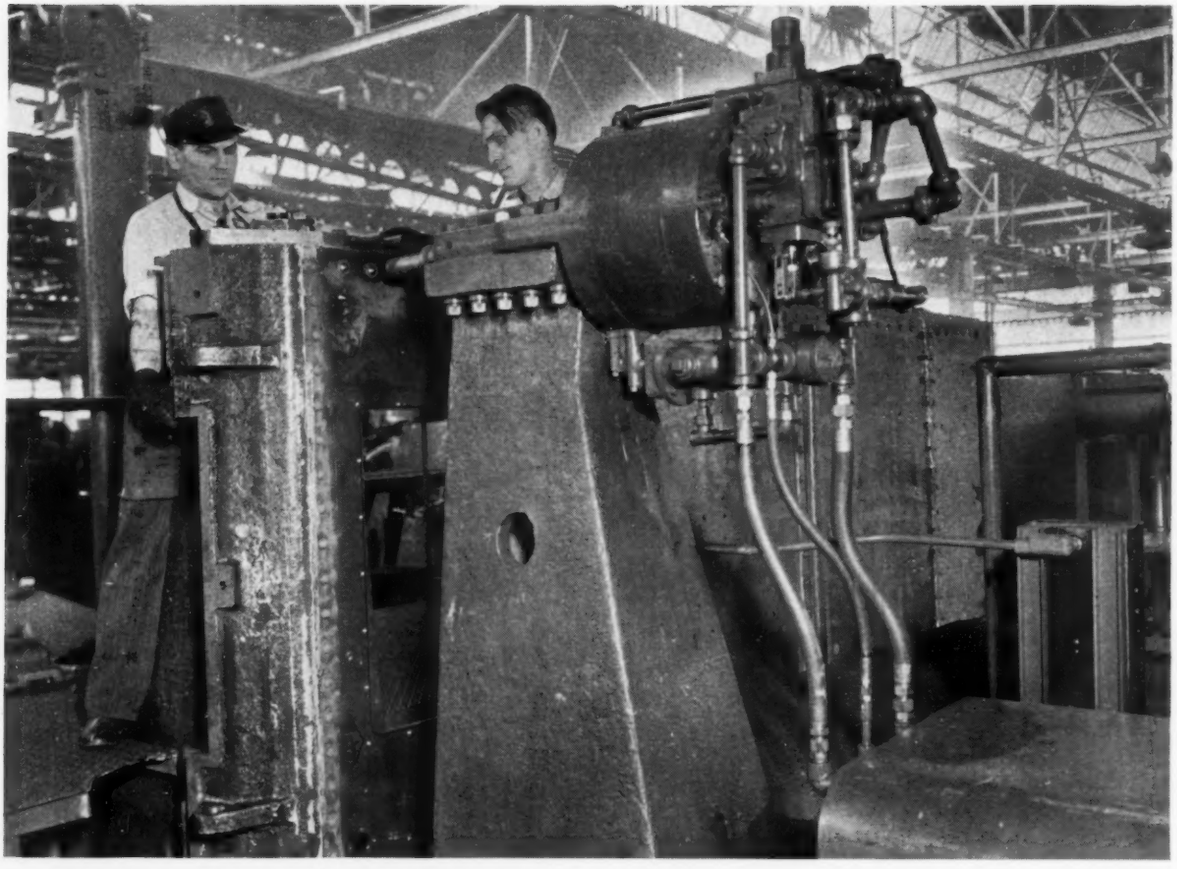
Fifth Operation—Semi-finish turn the hub outside diameter to a 0.002 in. limit, and face the rim on same side of gear. The part is located from the bottom of the splines by a three-point expansion arbor, to average the discrepancy between the splined and bored holes.

Sixth Operation—Green grind the hole to a 0.001 in. limit. The part is located in a special holder which is piloted in the chuck in such a manner that the chuck can be used for other purposes. The previously turned hub is entered in the pilot hole of the fixture and the rim is located against three buttons by means of bolts passing through the web holes.

Seventh Operation—Finish turn the outside diameter of the gear to a 0.005 in. limit and finish straddle-face the rim to +0.010 in. —0.000 in. The part is located from the green-ground hole by a round arbor. This operation trues the outside diameter



Final-drive gears are shaved before carburizing, right- and left-hand gears being handled with suitable cutter changes. Teeth are not ground after hardening; lapping is employed when required



After the bottom-plate assembly is bolted together in a large fixture and the smaller rivets driven with hand tools, the work is transferred to this riveting equipment where a number of 5/8-in. rivets are hydraulically driven to complete one of the major subassemblies

parallel with the hole and removes the rim weave.

Eighth operation—Grind the face of the short hub and the gear rim on the same side to a total limit of 0.0025 in. This tolerance on the hub and rim faces must be held for quenching in dies in order to prevent distortion.

The teeth are rough and semi-finish cut on gear shapers, chamfered, and shaved. After the carburizing, hardening, drawing and shot-blasting operations, the herringbone gear has the bore inside diameter ground while the part is held in a chuck taking location from the pitch line of the teeth. The last important machining operation is that of grinding the outside diameter of the long hub and the adjacent face.

Military regulations forbid the disclosure of the thickness of armor plate on the M-3 tank. But it can be said that the armor-plate hull consists of right- and left-hand side assemblies, a front assembly, a rear assembly and the bottom plate assembly. These main hull subassemblies are produced in eight bays running from the incoming-material side of the Tank Arsenal to hull-assembly line on opposite side.

All armor plate is received in the heat-treated condition and with the rivet holes drilled to templet. It is the Arsenal's job to join the various pieces of armor plate by riveting them to angle-iron backing members at the joints and to add various brackets and castings. Since even the comparatively small pieces of armor plate are too heavy to lift, the subassembly bays are provided with a large number of overhead electric hoists for transporting work pieces and subassemblies, as well as supporting them vertically between the jaws of hydraulic riveters.

Fixtures are used extensively for making minor subassemblies that go into the major subassemblies. The problem is to fit the armor-plate pieces tightly together at the joints. Drifts cannot be used. The rivet must fill the hole without question. A few thousandths of stock is left in the holes in the angle-iron backing members for reaming purposes, the hole in the armor plate acting as the guide.

Inland Sites for New Arms Plants

By LIEUT.-COL. ROBERT GINSBURGH,
Chief, Procurement Information, Bureau of Public Relations, War Department

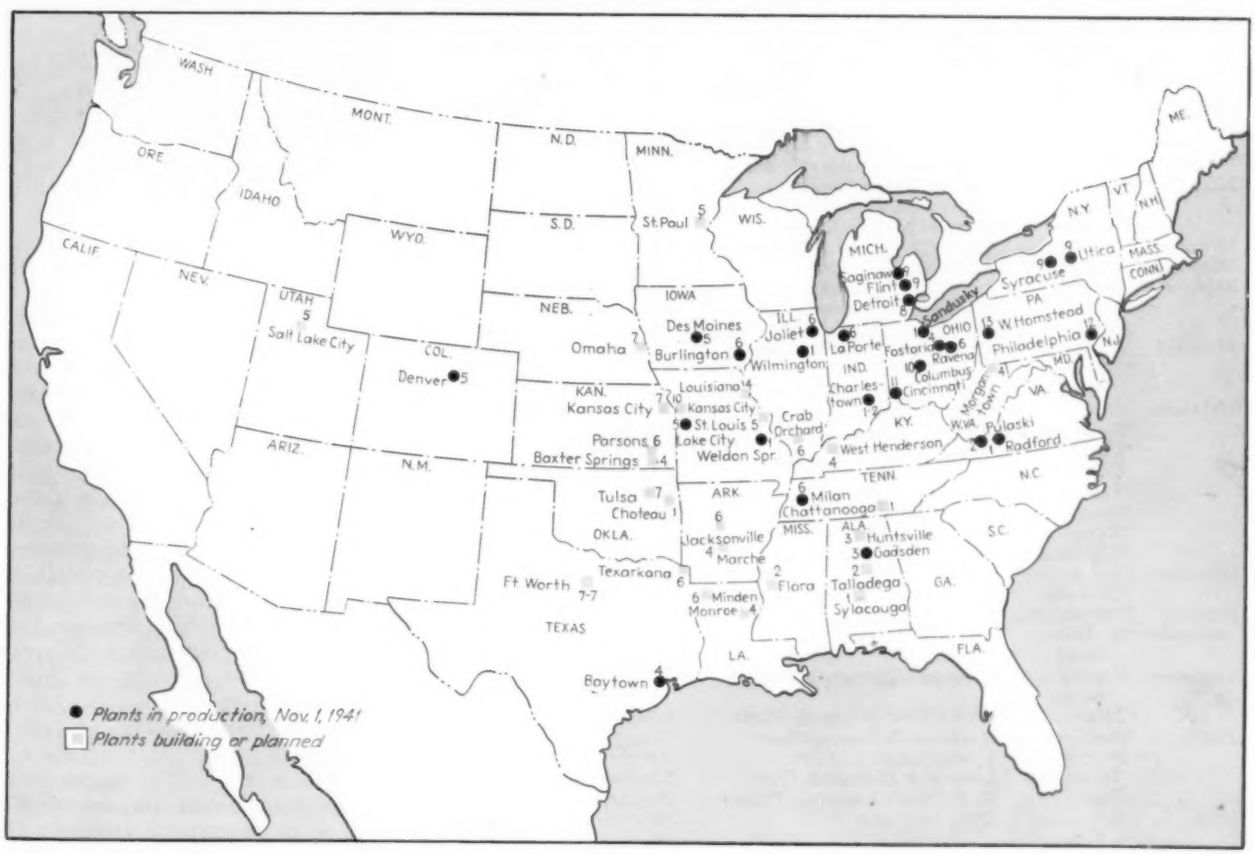
ON JULY 19, 1940, the War Department announced the award of a contract to E. I. DuPont de Nemours and Company for the construction and operation of a smokeless powder plant for the Ordnance Department of the United States Army at Charlestown, Ind. Thus began not only the Army's expansion program in the production of munitions to meet needs of modern battle but, also, a deliberate attempt on the part of the government to disperse the arms industry.

In July, 1940, the munitions industry of America was concentrated principally in the industrial triangle of the east, marked roughly by Boston, Pittsburgh and Norfolk, and in Southern California. Today it is scattered throughout the country as the accompanying map indicates. Smokeless powder is pouring out of Radford, Va., and Charlestown, Ind.; small arms ammunition from Denver, Colo., Lake City, Mo., and St. Louis; TNT from Joliet, Ill., and Weldon Springs, Mo.; machine guns from Saginaw and Flint, Mich.; and toluol from Baytown, Tex. The wide dispersion of these plants is converting farm areas into industrial centers and is changing the economic map of America.

In the selection of sites, the War Department was governed by two considerations, one military and the other economic. The military factors are the elements of time and strategy. The economic factors are the same as those considered by private industry.

Of the military factors, time is paramount. Time is priceless in industrial mobilization. Given the choice between an ideal site which can be developed after a lapse of many months and a less favorable one which can be converted into a producing factory in a shorter time, the latter must be selected. For that reason we find that the War Department had to expand in congested industrial regions. When plant facilities could be developed just as speedily outside the congested areas, the War Department invariably moved toward the interior of the country.

There are situations when time can be saved by utilizing existing supervisory skills which, if spread too thin, might retard development. Then, too, it becomes preferable to select a site in an existing industrial area. The tank and engine factories of the Detroit area are examples. By locating



Numeral at each location indicates type of plant:

Explosives (1)	Shell (3)	Ammunition (5)	Aircraft (7)	Machine Guns (9)	Metal Mirrors (11)
Bag Loading (2)	Chemicals (4)	Shell Loading (6)	Tanks (8)	Clothing Renovation (10)	Armor Plate (12)
					Artillery (13)

plants there, the War Department was able to make full use of the talents that have gone into the development of the automotive industry.

Detroit also presents a strategic problem. To play safe, the War Department prefers not to build new munitions factories within two hundred miles of our coasts and borders. In the interests of speed, this military principle had to be compromised. Each new construction in the "forbidden" areas, however, has had to submit a strong brief in its defense. In general, the trend has been to get into the heart of America.

In selecting these interior sites the following factors were considered:

1. Suitability to production requirements.
2. Availability of skilled and unskilled labor.
3. Availability of transportation.
4. Availability of power and water.
5. Closeness to raw materials and other contributory factors.
6. Proximity to markets for necessary by-products.
7. Sufficiency of area.
8. Configuration of site—that is, for ease of construction.
9. Availability of housing.
10. Safety considerations, both external and internal.
11. Proximity to storage points.
12. Integration with other plants in the program.
13. Avoidance of undue dispersion of operators' trained personnel.
14. Recommendations of the selected operator.
15. Cost of necessary real estate.
16. Climatic conditions.
17. Post-war effect.

The mechanics of selection follow. The War Department, through the office of the Under Secretary of War, maintains a coordinating system for this purpose which has its nerve center in what is called the Facilities Board. Through this board liaison is maintained with the Supply Arms and Services involved in each case, as well as with the Plant Site Committee of the Office of Production Management. The impetus in proposing a site always comes from the service most concerned.

For example, the Ordnance Department recommends a certain location to the facilities board. The board then checks the proposed location in accordance with the minimum requirements that have been laid down for all new munitions plants. It is understood, of course, that before the Ordnance Department or the Chemical Warfare Service or any other division in the War Department initiates a project, the preliminary study of the proposed site has been made. In many cases the assistance of other services is secured in determining the feasibility of the location proposed.

When all considerations are met, the facilities board recommends the site to the Site Board of the OPM. The OPM then checks on the sufficiency of labor, of raw materials, of by-products and on the other factors involved in order to provide a check on the initial investigation. It then either approves or disapproves the recommendation. If it approves, the facilities board sends the recommendation to the President, requesting approval. When the President's consent is obtained, authorization is given for construction by the office of the Under Secretary of War. In case of disapproval by the site board, the supply arm or service is given the chance to restate its desire for the original site or to recommend another. The facilities board then takes the matter up again with the site board, and the problems are considered until the difficulties are ironed out.

NEW U. S. GOVERNMENT OWNED MUNITIONS PLANTS

(Asterisk marks those in production, November 1, 1941.)

State	Town	Name	Type
Alabama	Sylacauga	Alabama Ordnance Works	Smokeless powder, TNT, DNT and Tetryl Depot
	Talladega	Coosa River Plant	Bag loading
	*Gadsden	Gadsden Ordnance Plant	Shell forging and machining
	Huntsville	Redstone Ordnance Plant	Chemical shell
Arkansas	Jacksonville	Arkansas Ordnance Plant	Loading
	Marche	Maumelle Ordnance Works	Picric acid
Colorado	*Denver	Remington Arms Co., Inc.	Small arms ammunition
Illinois	*Joliet	Elwood Ordnance Plant	Loading
	Crab Orchard	Illinois Ordnance Plant	Loading
	*Wilmington	Kankakee Ordnance Works	Tetryl, TNT and DNT
Indiana	*Charlestown	Hoosier Ordnance Plant	Bag loading
	*Charlestown	Indiana Ordnance Works	Smokeless powder
Indiana	*La Porte	Kingsbury Ordnance Plant	Shell and bomb loading
Iowa	*Burlington	Iowa Ordnance Plant	Loading plant
	Des Moines	Des Moines Ordnance Plant	Small arms ammunition
Kansas	Baxter Springs	Jayhawk Ordnance Works	Ammonium nitrate
	Parsons	Kansas Ordnance Plant	Loading
	Kansas City	North American Aviation, Inc.	Aircraft assembly
Kentucky	West Henderson	Ohio River Ordnance Works	Anhydrous ammonia
Louisiana	Monroe	Dixie Ordnance Works	Anhydrous ammonia
	Minden	Louisiana Ordnance Plant	Loading
Michigan	*Detroit	Detroit Tank Arsenal	Medium tanks
	*Flint	General Motors Corp.	Machine guns
	*Saginaw	General Motors Corp.	Machine guns
Minnesota	St. Paul	Twin City Ordnance Plant	Small arms ammunition
Mississippi	Flora	Mississippi Ordnance Plant	Bag loading
Missouri	*Lake City	Lake City Ordnance Plant	Small arms ammunition
	Louisiana	Missouri Ordnance Plant	Ammonia
	Kansas City	QM Clothing Renovation Plant	Clothing renovation
Missouri	St. Louis	St. Louis Ordnance Plant	Small arms ammunition
	*Weldon Springs	Weldon Springs Ordnance Works	TNT and DNT
Nebraska	Omaha	Glenn L. Martin Co.	Aircraft assembly
	*Syracuse	General Motors Corp.	Machine guns
	*Utica	Savage Arms Co.	Machine guns
Ohio	*Columbus	Government — QMC	Clothing renovation
	*Fostoria	National Carbon Co., Inc.	Chemicals
	*Sandusky	Plum Brook Ordnance Co.	TNT and DNT
	*Ravenna	Ravenna Ordnance Plant	Loading
	*Cincinnati	U. S. Corps of Engineers	Metal mirrors
Oklahoma	Tulsa	Douglas Aircraft Co., Inc.	Aircraft assembly
	Choteau	Oklahoma Ordnance Works	Smokeless powder
Pennsylvania	*Philadelphia	Henry Disston & Son	Armor plate
	*W. Homestead	Mesta Machine Co.	Artillery and parts
Tennessee	Chattanooga	Volunteer Ordnance Works	TNT and DNT
	*Milan	Wolf Creek Ordnance Plant	Loading
Texas	*Baytown	Baytown Ordnance Plant	Toluol
	Fort Worth	Consolidated Aircraft	Aircraft assembly
	Texarkana	Lone Star Ordnance Plant	Loading and assembly
	Fort Worth	U. S. Gov't Assembly Plant	Bombers
Utah	Salt Lake City	Utah Ordnance Plant	Small arms ammunition
Virginia	*Pulaski	New River Ordnance Plant	Bag loading
	*Radford	Radford Ordnance Plant	Smokeless powder, pentolite
West Virginia	Morgantown	Morgantown Ordnance Works	Synthetic ammonia

AMERICAN MACHINIST REFERENCE BOOK SHEET

Machine Tool Electrical Standards—I

THESE STANDARDS, adopted by the National Machine Tool Builders' Association September 5, 1941, apply to machine tools coming within the following classification; "Power driven, complete metal working machines not portable by hand, having one or more tool and work holding devices, used for progressively removing metal in the form of chips."

1. The purpose of outlining these methods is to arrive at a standard for the electrification of machine tools that will meet the requirements of the user and relieve him of the necessity for accompanying each order with specific instructions. If they meet with general acceptance they will make it possible for machine tool builders to handle the application of motors and control on a production basis and eliminate the delay, expense and confusion which inevitably result from attempts to follow special instructions.

2. Since the most important consideration is the safe and convenient operation of the machine, and this is a matter in which the machine tool builder is expert, it is strongly recommended that the customer leave to the machine tool builder the task of selecting, purchasing and applying the equipment to the machine. The proper selection of control has become an integral part of machine tool design, and is no longer a secondary consideration. The final responsibility for successful operation of the completed unit, comprising both mechanical and electrical details, cannot otherwise be safely assumed by the machine tool builder.

3. Whenever practical, the machine tool builder shall use the make of motor and control the customer prefers.

4. When the machine is to be installed under unusual conditions as to temperature, dust or dampness, the customer shall so advise the machine tool builder in making his inquiry.

5. On any point for which specific provision is not made in these specifications, the provisions of the National Electrical Code shall be observed at all times.

Wiring Diagrams

100. On machines having only one motor and one starter, the controller wiring diagram normally furnished with the starting equipment, shall be considered satisfactory, provided the diagram shows all of the electrical equipment on the machine.

101. Where more than one motor or starter is used (if the motors are not entirely independent) a special diagram shall be furnished making use of standard symbols and showing all of the electrical connections including the numbers on wires or terminals.

102. The wiring diagram shall be furnished in the electrical compartment to ensure that it will be available to the electrician working on the machine.

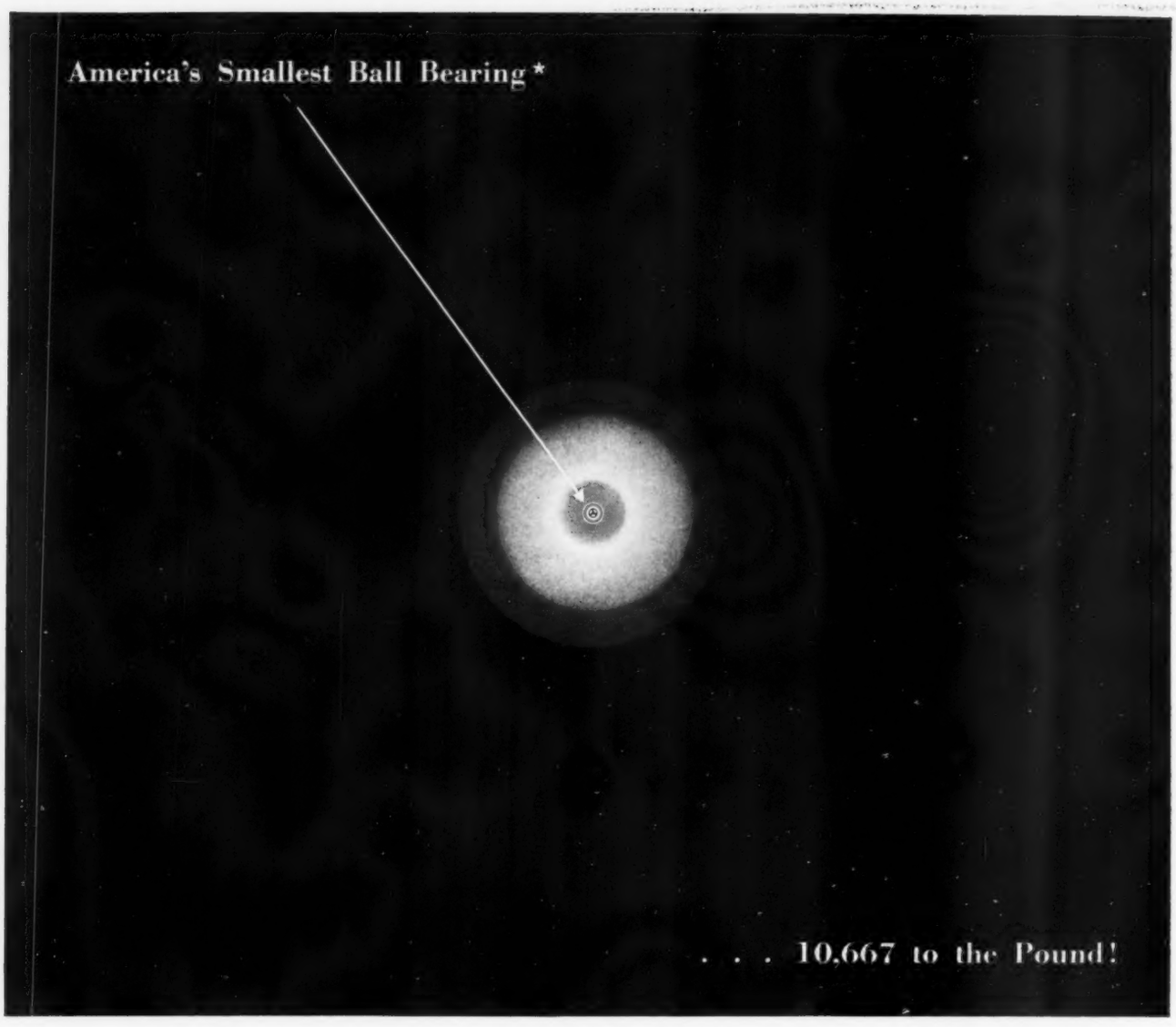
Elementary Diagram

103. When more than one starter is used (if the starters are not entirely independent) an elementary diagram shall be included in addition to the wiring diagram. When requested by the user or deemed necessary by the

N.E.M.A. INDUSTRIAL CONTROL STANDARD DEVICE MARKINGS*

Armature acceleration	A	Field protective (field weakened at standstill)	FP	Low speed	LS
Armature shunt	AS	Field reversing	FR	Low torque	LT
Aux. sw. (breaker) normally open	"a"	Field weakening	FW	Low voltage	LV
Aux. sw. (breaker) normally closed	"b"	Final limit — forward	FLF	Master switch	MS
Balanced voltage	BV	Final limit — reverse	FLR	Maximum torque	MT
Brake	BR	Final limit — hoist	FLH	Middle landing	MLD
Compensator — running	MR	Final limit — lower	FLL	Main or line	M
Compensator — starting	MS	Final limit — up	FLU	Motor field	MF
Control	CR	Final limit — down	FLD	Overload	OL
Door switch	DS	Forward	F	Pilot motor	PM
Down	D	Full field	FF	Plug	P
Dynamic braking	DB	Generator field	GF	Reverse	R
Field acceleration	FA	High speed	HS	Series relay	SR
Field deceleration	FD	Hoist	H	Slow down	SD
Field discharge	FD	Jam	J	Thermostat	TS
Field dynamic braking	DF	Kick off	KO	Time	T
Field failure (loss of field)	FL	Landing	LD	Up	U
Field forcing (decreasing on variable voltage)	DF	Limit switch	LS	Undervoltage	UV
Field forcing (increasing on variable voltage)	CF	Lowering	L	Voltage relay	VR

* The markings or letters in this table are intended for use with the symbols shown in the sketches in these Reference Book Sheets. The markings and symbols are for use in wiring diagrams to indicate the function or use of the particular device.



● Yet even New Departure, with its vast resources can hardly make them fast enough to supply the pivots of pointers on aircraft instruments. From these tiny "jewels" to the mighty 30-pound bearings for massive military units, New Departure's day-and-night effort is for Democracy's defense.

New Departure, Division of General Motors, Bristol, Conn. Detroit, Chicago and San Francisco.

Nothing Rolls Like a Ball

*** Details**

New Departure's C-270 with three 1-millimeter balls, a separator and a race ring of only 2.7 millimeters diameter, provides the extreme sensitivity in delicate aircraft instruments without the danger of cracking from vibration which is possible with jewels.

New Departure

. . . a vital defense product

3039

Machine Tool Electrical Standards—II

machine tool builder a description of the sequence of operations shall be furnished.

Standard Symbols

104. Wiring diagrams shall employ the symbols shown in the accompanying sketches.

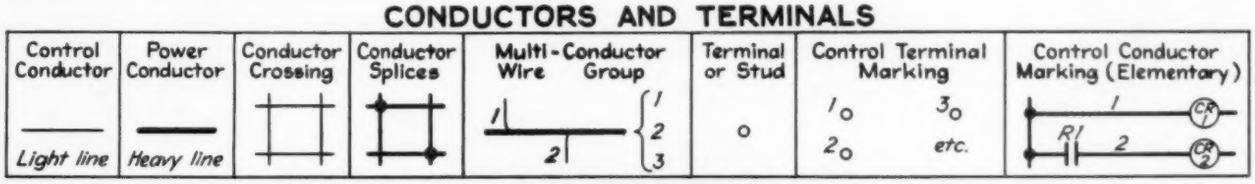
Conduit Layout

105. On large machines requiring a special foundation, the size, purpose and location of conduit and incoming lines that must be installed by customer shall be shown on the foundation plan.

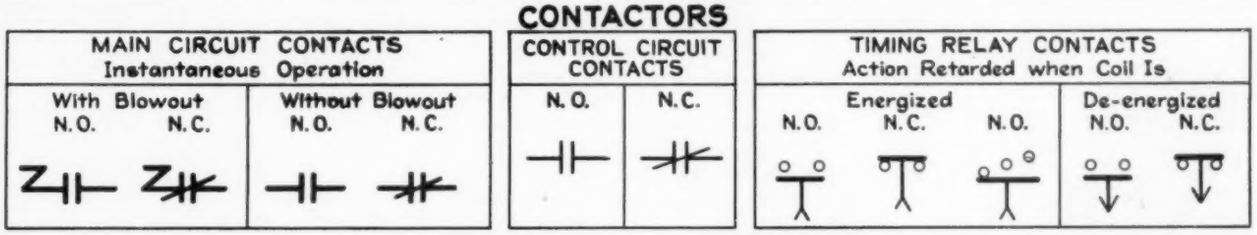
The balance of this standard will appear in an early number.

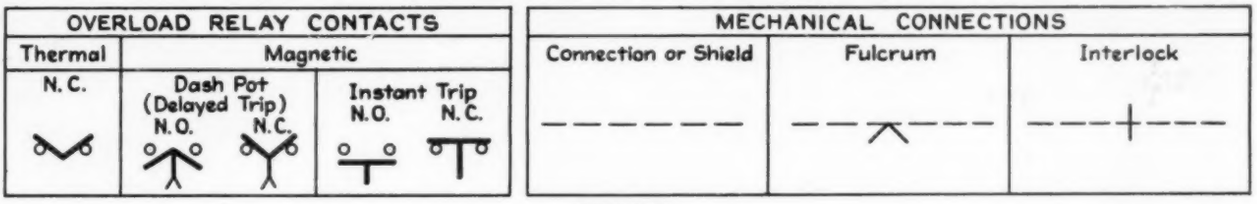
Standard Wiring Diagram Symbols

CONDUCTORS AND TERMINALS

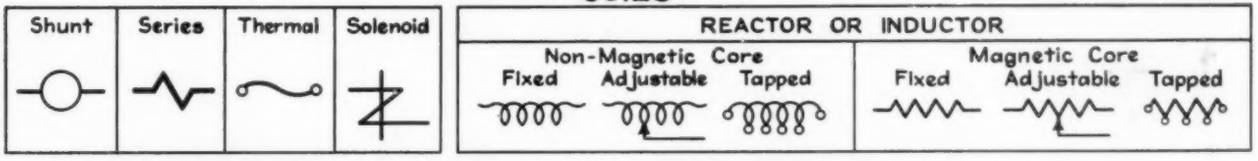


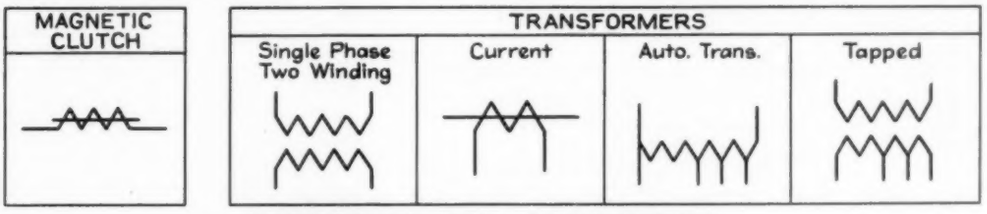
CONTACTORS



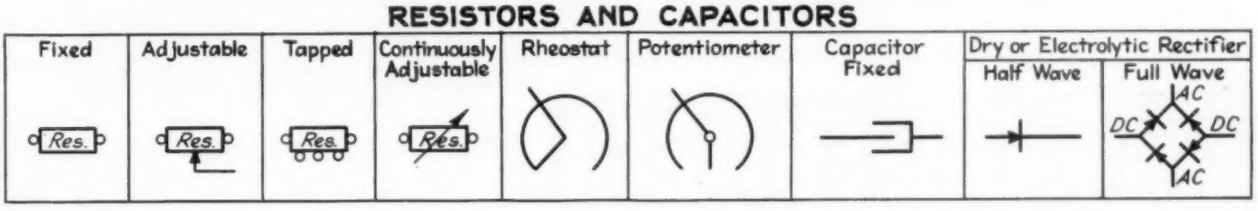


COILS





RESISTORS AND CAPACITORS



RIGHT or WRONG?

. . . TEST YOUR KNOWLEDGE OF "ACORN" DIES

"*Acorn*" Dies are furnished in 5 different sized blanks.

Regular "*Acorn*" Die holders for screw machines that reverse die or rod automatically.

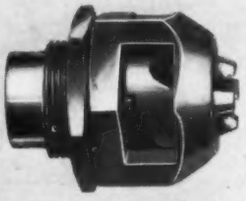
HERE are 12 questions about "*Acorn*" Dies. Out of 7 tool foremen who recently tackled them, only one was able to score 100%. How about you? Don't peek at the answers in the lower right corner till you've checked your knowledge.

1. "*Acorn*" Dies can be used on all makes of hand or automatic screw machines, turret lathes, bolt cutters, drill presses, etc. ☐ Right ☐ Wrong
2. "*Acorn*" Dies can only be used on fixed centers. ☐ Right ☐ Wrong
3. "*Acorn*" Dies are adjustable. ☐ Right ☐ Wrong
4. "*Acorn*" Dies do not require lead screws on machines on which they are used. ☐ Right ☐ Wrong
5. "*Acorn*" Dies can be used on any machines which reverse either the die or rod when the desired thread length has been cut. ☐ Right ☐ Wrong
6. There is only one size of "*Acorn*" Die blank for all thread sizes. ☐ Right ☐ Wrong
7. There are standard holders which permit "*Acorn*" Dies to be used with "button," spring or floating die holders. ☐ Right ☐ Wrong
8. Smaller than ordinary "*Acorn*" Dies can be used with a given holder. ☐ Right ☐ Wrong
9. Each size of "*Acorn*" Die holder is available with only one size shank. ☐ Right ☐ Wrong
10. Genuine "*Acorn*" Dies have an exclusive patented "heel" on the cutting lands that prevents tearing threads on reversal. ☐ Right ☐ Wrong
11. "*Acorn*" Dies are so uniform in size that they can be removed for sharpening, or changed without checking machine set-up. ☐ Right ☐ Wrong
12. A special fixture is needed to hold dies for sharpening. ☐ Right ☐ Wrong

For years "*Acorn*" Dies have hung up amazing records on various types of production work. Consider them for any job where dies seem to wear out rapidly.

GREENFIELD TAP AND DIE CORPORATION
GREENFIELD, MASSACHUSETTS
DETROIT PLANT: 2102 West Fort St.
WAREHOUSES in
New York, Chicago and Los Angeles
In Canada: GREENFIELD TAP AND DIE CORP. OF CANADA, LTD., GALT, ONT.

Releasing "*Acorn*" Die holder for hand screw machines.



"*Acorn*" Die Adapter, for button, spring or floating holders.

This is one of a series of advertisements published by Greenfield Tap & Die Corporation to help users get greater production from their small tools in these critical times, through making useful facts more widely known

GTD GREENFIELD
TAPS • DIES • GAGES • TWIST DRILLS • REAMERS • SCREW PLATES • PIPE TOOLS

1. Right	5. Right	9. Wrong
2. Wrong	6. Wrong	10. Right
3. Right	7. Right	11. Right
4. Right	8. Right	12. Wrong

Guns and Gadgets

ONE NEW YEAR'S prediction can be made with certainty. Nineteen forty-two will be a year when less and less materials will be available to more and more companies. The limiting factor in defense as well as non-defense production will not be manpower or plant facilities, but materials.

Firms making armament and allied items will get what they need. But manufacturers outside that charmed circle are face to face with an uncertain future. Acute shortages loom in various materials. The necessity is at hand for spreading out available stocks and distributing them as equitably as possible.

Nothing should be done which might retard the defense program even in the slightest degree. At the same time action should be avoided in Washington which will deprive non-defense industries of essential materials unless there is no other way out.

If ever a national situation called for the spontaneous cooperation of a free people, it does now. And that applies to the Army, Navy, defense contractors and makers of civilian goods.

Such cooperation must take the form of cutting to a minimum the use of critical materials, of seeking of workable substitutes and of eliminating frills from all products.

As Donald Nelson pointed out last week, up until a few months ago this country had more materials than it knew what to do with. During most of the last decade we have had an embarrassment of surpluses. There was no incentive to go slow in the use of materials when designing a product.

Almost overnight industry is asked to do an about-face. The emphasis has shifted over to saving a little here and a little more there, all in the interest of making a particular material go farther in the national economy.

It is not an easy task for us to revolutionize our habits so speedily. But our national interest demands that it be done. And an excellent start has been made.

Out-and-out substitution of one material for another will help. The Army, for example, is experimenting with steel shell cases which, if proved feasible, will relieve considerably the pressure for copper. Many companies already have made notable progress in replacing critical materials with those of which the supply is more plentiful.

Then there is the use of less critical materials in each item manufactured. Plating of some products, for instance, is thinner than formerly, but serves the purpose.

Simplification of lines of products offers itself as another method of saving materials. The case of a refrigerator maker illustrates the point. It has had a de luxe line, a standard product and an economy line. Now it is temporarily shelving the first two and concentrating on the economy line. The refrigerators made by this company won't have all the fancy trimmings which customers have become accustomed to, but their utilitarian value will be just as great.

It is the responsibility of every manufacturer, whether turning out a defense product or civilian goods, to make vital materials go as far as possible in these critical times. If all industrialists will assume that responsibility, we probably can have some butter along with guns. But, to echo the remarks of Mr. Nelson, we might as well make up our minds now that for the duration of the war we can't have guns and gadgets.

Burnham Finney

GAGING BUSINESS

Machine tool shipments to England drastically cut. Makers of critical tools to be asked to expand further. New ordnance program in the making. Plane production over 2,000 a month

Despite pleas of the British for shipment of more machine tools to England to help expand aircraft and munitions manufacture there, defense authorities at Washington have decided upon a drastic cut in the volume of machines now being sent abroad. For at least the next few months machine tool builders are being asked to divert to defense plants in this country the machine tools which were originally ordered by the British and will be ready for shipment to them. The exceptions will be highly specialized tools which cannot be adapted to use in this country. This new ruling will tend to retard machine tool production because in most cases the actual tooling on the machine tools destined for England will have to be changed to make the machines suitable for defense jobs here. It is known that the Controller-General for machine tools for Britain was in Washington recently in an attempt to secure a larger percentage of the U. S. machine tool industry's output for the war plants of England. He is reported to have returned to London almost empty-handed. The reasons for this shift in policy, whereby Britain is to get far less machine tools rather than more, have not been made public.

Machine Tools—A complex situation exists in the machine tool industry in that companies making critical tools have backlogs which extend over the better part of a year or longer, while firms building some other types have open spots in their order books during the next two to four months. Where machine tool builders have over-capacity business in critical tools for the next nine months to a year, pressure is being exerted on them by Washington to expand still farther their productive facilities, even though they may already have enlarged their capacity two or three times since the defense program began. Subcontracting is being done to a greater degree than ever before by the industry. The industry's production rate is expected shortly to hit a billion dollars a year, compared with an average peacetime rate of $100,000,000 annually. Some companies with tool orders for the "E" bomber program, covering the requirements of subcontractors, report that few orders have yet been placed by the subcontractors, thus necessitating storage of completed machines. Machines ordered under the Lend-Lease plan also have been stored because of the delay in Washington in deciding where machines should go.

Aircraft—Plane production is close to the schedule set up a year ago. It is over 2,000 military-type planes a month and will be about 3,000 a month by the middle of next year. Engine output has improved notably. Allison is up to 1,000 units a month and Pratt & Whitney's production in November was large enough to power 850 twin-engine bombers of the Lock-Heed Hudson or Martin Mary-Land types.

Munitions—In addition to the ordnance appropriations totaling billions of dollars now before Congress, a new ordnance program calling for six or seven billions is in the making. This program is said to contemplate the erection of many new ordnance plants around the country, over and above the plants already finished or in process of construction. Important new dealers will fight the expansion idea, believing that the country's present machine capacity should be fully utilized before beginning construction of more brand-new plants. The Ordnance Department of the U. S. Army has arranged for the construction or expansion of the country's rivetless armor casting facilities at a cost of $53,500,000. Production of Barbette carriages and of newly-designed armor plate hoods for six-inch guns has started.

Shipbuilding—Three hundred thousand new workers will be needed by shipyards before the end of 1942, when operations are expected to reach a peak. Some 265 shipyards now hold contracts for ships for the Navy or the Maritime Commission. Westinghouse has begun construction at its South Philadelphia and East Pittsburgh works of turbine electric propulsion units for 35 tankers.

Steel—The year's production of steel ingots probably won't exceed 82,000,000 tons because of the shortage of scrap. Civilian allowance of 22,000,000 tons for 1942, as against an average consumption of 40,000,000 tons in recent years, means that some industries may get only 35 percent as much steel as they did last year.

GOVERNMENT DEFENSE ORDERS IN BRIEF

ALUMINUM PLANT—Preference Rating Order P-19-b assigns a preference rating of A-1-b for use in obtaining materials and supplies for the construction of an aluminum plant at Massena, N. Y.

BRIGHT FINISH—The automotive industry will have until December 31 to use up existing stocks of bright finish containing aluminum, copper, nickel, chrome.

CHROMIUM—General Preference Order M-18-a places full control of chromium deliveries in the hands of the Director of Priorities. An amendment to order M-21-a prohibits manufacture and delivery of alloy iron or steel containing more than 4 percent chromium, except on A-10 or higher preference rating.

FIRE FIGHTING EQUIPMENT—Preference Rating Order P-45-a grants an A-8 rating to the U. S. Forest Service in obtaining fire fighting equipment.

FOIL—Operation of Limitation Order L-25 restricting the use of lead and tin foil has been postponed until Dec. 24.

FOUNDRY EQUIPMENT—Preference Rating Order P-31 granting ratings to orders for materials essential to manufacture of foundry equipment has been extended to May 30.

LEAD—Supplementary Order M-38-b requires every refiner of lead to set aside 15 per cent of his December production for allocation.

PIG IRON, STEEL—General preference orders M-21, M-17, M-21-a and M-21-b covering pig iron and steel have been extended to Dec. 31.

TRUCK, CAR PARTS—An amendment to Limitation Order L-4 gives manufacturers of light truck and passenger car replacement parts choice of either Jan. 1–June 30 or July 1–Dec. 31 as base period on which to figure production. An A-10 preference rating was granted for materials.

ZINC—Producers of metallic zinc are required to set aside 29 percent of amount produced in August for the December pool.

TUNGSTEN STEEL USE CUT

WASHINGTON—Only 25 percent of high-speed steel orders which manufacturers are allowed to accept in any one quarter can be of the tungsten type, according to an Office of Production Management amendment to General Preference Order M-14. The remaining 75 per cent must be of the molybdenum variety.

Reason for the change from the previous 50-50 ratio are recent Japanese threats to sever the Burma Road, route over which Chinese sends tungsten to the U. S. in return for Lease-Lend munitions. Despite large boosts in domestic production since the defense program got under way, we still depend for the most part on China for tungsten. Most of our molybdenum is produced at home.

PRIORITY HELPS FURNACE MAKERS

WASHINGTON — Manufacturers of furnaces used in the heat-treatment of metals are granted the assistance of an A-1-c priority rating in acquiring necessary materials, in Preference Rating Order P-74 issued by the Priorities Division, Office of Production Management. The rating may be applied by some 50 manufacturers to purchase orders for a long list of component parts and materials, including motors, mechanical parts, alloys, instruments, refractories, burners, paints and foundry supplies.

Nearly All Manufacturers Can Obtain Help Of Blanket Priority Rating by Filing PD-25a

WASHINGTON—A scheme under which nearly all manufacturers who do much defense business can get the benefits of the blanket priority ratings now enjoyed by a few industries working mostly on defense has been put into effect by Priorities Division. Ever since last March, the Office of Production Management has been granting blanket ratings to selected industries —ranging from machine tool production to tackle block manufacture. In a single document, such a rating enabled the favored manufacturer to get priority on all his purchases of specified items. Manufacturers who combine defense with non-defense use have had a more difficult time buying materials.

Good for Three Months

The new set up, known as the Production Requirements Plan, gives a blanket rating—high or low depending on the importance of the project—for purchases of goods going into the defense portion of a manufacturers work. The rating is limited to specific quantities of specific materials and is good for a three-month period. Manufacturers doing several types of defense or essential civilian work will get several different ratings.

To get such a rating, a manufacturer files an application form PD-25a. In this he will set forth the kind and volume of his production, the priority ratings on the orders he fills, the end use of his product, his inventories on hand, and the amount of materials he expects to need during the coming quarter year.

Will Provide Inventory Picture

An important by-product of this scheme is that, as OPM accumulates a file of PD-25a applications, it will get a clear and discriminating picture of the inventory picture and material needs of most of industry. Such a picture is exactly what is required in order to set up the allocations system that Supplies, Priorities and Allocations Board is working towards. Thus, PRP is likely to merge eventually into an allocation system.

PRP is not in itself an allocation system. It might give a manufacturer a rating of A-7 on steel up to a thousand tons; if there turns out to be enough steel to fill the A-7 ratings, he will get his. However, as OPM gathers accurate information on the needs of industry, it will be able to adjust the number of ratings it issues to the probable supply. Gradually it will become more and more certain that if you have a rating you will get the stuff. Until finally the ratings can be dropped and simple allocations substituted.

New Tank Face—*Workmen at American Locomotive Co. plant in Schenectady put finishing touches on M-3A1 tank for the Army. Similar to the M-3 in armament, the new model has one-piece, cast-steel hull. Advantages claimed over previous riveted hulls are deflection of shell, speedier assembly*

Army Prepares Facilities For Cast-Steel Tank Armor

WASHINGTON—Facilities being developed by the Army for production of welded cast-steel armor for next year's models of tanks were revealed in a report of the Bureau of Ordnance. Foundry facilities for producing armor castings are to be installed at American Steel Foundry Co., East Chicago, Ill.; Scullin Steel Corp., St. Louis, Mo.; and Symington-Gould Corp. Plants for the manufacture of welded hulls and turrets will be built for General Steel Casting Corp., Granite City, Ill., and Continental Roll & Steel Foundry Co., East Chicago.

All tanks currently in regular production—M-3 medium and M-3 light—are riveted and use forged or rolled armor. American Locomotive Co., however, is preparing to produce soon a cast armor M-3A1 tank at Schenectady, N. Y. Next year's tank will be the M-4, a welded tank using cast armor and incorporating many other improvements. Production will be when the run of M-3s is completed. There is no intention of cutting short M-3 production to make an earlier changeover. Although nothing has been said officially, it is assumed that a light welded tank of cast armor is contemplated.

Crucible Gets Its "E"—*Atha Works of the Crucible Steel Co. of America recently received the coveted Navy "E" pennant and Bureau of Ordnance flag for production excellence. Shown left to right at the presentation are A. E. Van Cleve, works manager; Rear Admiral H. G. Bowen, Federal Shipbuilding & Dry Dock Co.; Rear Admiral H. P. Blandy, chief, Bureau of Ordnance; Mayor F. B. Gassert of Harrison, N. J.; and F. B. Hufnagel, chairman of the board, Crucible Steel Co. Atha Works has contracts of nearly $100,000,000 for U. S. armed forces, Great Britain and Canada*

OPM Allocates Steel Plates, Curbs Chromium Alloy Use

WASHINGTON—Last fortnight, as the steel industry was recovering from the effect of the coal strike, Office of Production Management issued General Allocation Order No. 1, providing 100 percent control over the distribution of all steel plate production. Eighty or 90 percent was already allocated.

There isn't enough steel plate this month to fill all the A-10 orders. OPM hasn't got its industry requirement figures in shape yet for the thoroughgoing allocation program it's planning for next year, so this week it imposed an interim form of allocation. Plate producers each month will submit to OPM an estimated production schedule and a list of the shipments they propose to make—together with a list of the orders they intend not to fill. No shipments may be made until OPM has approved the schedule. For the present plate-buyers simply place their orders in the usual way; when forms have been worked out, they will have to submit advance schedules of need.

On November 27, three days before GAO No. 1, came two OPM orders sharply limiting the use of chromium steel. M-18-a authorizes Priorities Director Nelson to direct all deliveries of chromium. M-21-a says that no alloy iron or steel containing 4 percent or more chromium shall be manufactured and delivered except on A-10 or higher preference ratings. What this means is that all the high chromium content steel produced after December 1 will be retained for defense purposes, and that the nation's stock of chromium is earmarked for defense. Nearly half of our chromium comes from Africa, and nearly a third of it from the Philippine Islands.

HOUSE APPROVES APPROPRIATION

WASHINGTON—The House Appropriations Committee last week approved an $8,234,839,031 supplemental defense outlay, which will pay for equipment to increase the Army to 2,000,000 men and for doubling arms production. The appropriation includes $3,822,577,646 for tanks, anti-aircraft material, anti-tank weapons, artillery, combat vehicles and armament, ammunition, small arms, etc. Lend-Lease is allotted $1,272,499,266, with possible $500,000,000 more to come in the near future.

The administration tried to put the Army and Lend-Lease funds in one large pool but was turned down. For 20 to 30 additional plants to turn out the above provided arms, $388,000,000 are provided the Lend-Lease fund, and $78,000,000 are earmarked for Russia. The Navy will get $1,129,870,000. Funds for 60-ton tanks are included, as well as for 24 large marine corps transport planes.

This bill when passed will raise defense appropriations since July 1, 1940, to $67,990,254,096.

METAL PLATING LAB OPENED

NIAGARA FALLS—A service laboratory for the study and solution of customers' problems and for the development of improved metal treatment and electroplating processes, has been opened by the E. I. duPont de Nemours & Co. Inc., at the plant of the R. & H. Chemicals Department. The three-story brick building houses a cyanide products analytical and research laboratory, a metal treatment furnace room, an electroplating service laboratory, staff offices and rooms for metallographic preparation and photographic.

U. S. Speedily Replacing Ships Taken from Service

WASHINGTON—Few people realize that half of the 8,000,000 tons of merchant shipping under the American flag in 1939 has gone out of our service in the emergency. Army and Navy have taken 151 ships totaling 1,300,000 tons; about 1,000,000 tons were sold for foreign operation, mostly to the British; and about 2,000,000 tons have been turned over to anti-Axis countries under Lend-Lease and other arrangements.

Thus, with the Maritime Commission's construction program, including the C ships, tankers, and EC-2s just now tipping the million-ton mark, we have built only a quarter of our depletion due to the war.

One Launching Per Day

But, this December sees merchant ships being launched at the rate of one a day. Beginning in January, as scheduled, *deliveries* will attain the rate of one a day, speeding up to two a day by the middle of 1942. The program calls for completion of 1,200 ships totaling 13,500,000 tons by the close of 1943, or once-and-a-half over our tonnage in 1939—and *all new*. By long odds the United States will be the merchant marine master of the world.

The Commission has just contracted for 12 coastal tankers and four seagoing tugs, at a cost of $11,000,000. Barnes-Duluth Shipbuilding, Duluth, Minn., will build eight of the tankers. Lancaster Iron Works, Lancaster, Pa., will build the other four. Froemming Brothers, Milwaukee, Wis., will construct the four tugs. The tankers are 212 ft. long, diesel driven. Their capacity is 12,660 barrels. The tugs are 194 ft. 9 in. long with 2,250-hp. engines.

Engineers Pledge to Support Government In Defense Effort. Post-War Studies Recommended

NEW YORK—Full support of the engineering profession to the task of carrying out our government's pledges and restoring peace to the world was pledged by William A. Hanley, president of the American Society of Mechanical Engineers during the annual meeting of the society held here December 1-5. However, Mr. Hanley expressed the concern of engineers regarding post-war conditions. He stated "Unless the government is to put 15 to 20 million on W.P.A. and in CCC camps, the alternative is to prepare now to create jobs in private industry, and to plan to reduce government employees to a bare necessary number. Based on the estimate of the National Resources Planning Board," he added, "if the war continues, nearly half of the country's 55,000,000 workers in 1944 will be either in defense projects or under arms, and when the war ends we will have the colossal job of putting more than 26,000,000 workers back into peacetime employment." The success of private enterprise to continue and thrive as it did between 1790 and 1930 depends on individuals more than on corporations, municipalities and other groups, Mr. Hanley pointed out, and that as a nation we should reduce our peacetime expenditures now, so that we can accumulate money to spend, and then spend it, when the war is over.

The meeting of the society was attended by 16,000 members and guests who attended 43 technical sessions where over 100 papers were presented. Outstanding among the meetings were forum sessions where attending members directed questions to groups of experts on the speaker's dias. One such meeting dealt with conservation and reclamation of materials used in industry. Questions were prepared in advance of the meeting by canvassing members of the society. Answers prepared by the panel of experts were elaborated upon by both the experts and members attending. Another meeting of the same order elaborated on the selection and training of supervisors. Without exception, it was stated, supervisors were selected for their knowledge of their work, and supervisory requirements relative to personnel problems, labor relations, and managerial activities were taught to them later. Indication was made that training of supervisors could well begin with apprentices who, as a part of their training, might be taught both supervisory and managerial subjects along with production training in factories and shops.

J. W. Parker, right, inducted as A.S.M.E. president for 1942 at the Society's annual dinner December 3 discusses his new duties with retiring president William A. Hanley

John C. Garand, left, designer of the Garand rifle, was awarded the Holley Medal for his distinct contribution to our national defense. President William Hanley makes the presentation

Honorary membership in the A.S.M.E. was conferred upon Major General Charles M. Wesson, chief of ordnance, U.S.A. (left), Clarence D. Howe, minister of munitions and supplies for Canada (center), and Admiral Samuel M. Robinson, chief of the bureau of ships, U.S.N.

Lieut.-Col. H. F. Safford, works manager of Watervliet arsenal, related developments in rifling cannon, including mention of single-hook cutters with indexing attachments, disk broaching, and pull-bar broaching. Advantages and disadvantages of these were discussed from both production and design angles. At the same meeting of the machine shop practice division of the Society, H. E. Linsley, Wright Aeronautical Corp., told of the vast development in the mass production of aircraft engine parts. Details were given on the Wright plant at Cincinnati, Ohio, where a 50-acre plant was tooled-up for mass production of a single type engine.

Work accomplished by the National Inventor's Council was discussed by Col. L. B. Lent. He stated "about 40 percent of the ideas of potential value to the armed services are in the general field of ordnance, about 20 percent are in the aircraft field, and the remaining 40 percent cover other phases of warfare." Out of this, re-

In open forum, A.S.M.E. members asked these men "what is top management doing about the supervisory problem?" Those at the quiz board were, left to right, R. F. Gow, works manager, Norton Company, A. Sobey, Director, General Motors Institute, J. P. Kottcamp, vice-president, Johns-Manville, S. M. Lowry, director of industrial relations, Procter & Gamble Co., and R. E. Gillmor, president, Sperry Gyroscope Co.

Defense production was the subject of the machine shop practice division, Wednesday. Lieut.-Col. H. F. Safford, U.S.A., works manager, Watervliet Arsenal, right, discussed broaching rifling in cannon. H. E. Linsley, Wright Aeronautical Corp., left, spoke on mass production of aircraft engine parts. The meeting was in charge of J. Allan Harlan, office of ordnance department, U. S. Army

gardless of "crack-pot" schemes submitted, there will appear something radically new and potent in war equipment, according to Colonel Lent.

Engineers As Salesmen

Tell Berna, manager, National Machine Tool Builders' Association, speaking before the industrial marketing session of the meeting forcefully emphasized the need for basing industrial-equipment sales on accurate information, which information can best be given by salesmen trained in production engineering. Such men, contrasted with the "pure sales type," will be needed more and more to assist purchasers of industrial equipment on production problems, tooling, service requirements and, today, priorities. With training to deal with such problems, they not only will be able to serve their customers intelligently, but the manufacturing plant as well by supplying market data and customer need on which programs may be developed.

An interesting revelation regarding war industries in England was made by W. D. Binger, Commissioner of Borough Works, New York City and chairman of the National Technological Civil Protection Committee. He said he had been inside large factories, during a recent visit to the British Isles, where the entire working space was not less than 80 ft. underground. These factories are built in abandoned quarries, are completely air-conditioned and are bombproof because of the solid rock cover. Another interesting item of British effort is the fact that bomb damage to water mains, communication lines, transportation facilities, power equipment is repaired permanently after each air raid. No temporary repairs are undertaken.

Standardization of railway rolling stock and motive power was discussed by Ralph Budd, president, Edward G. Budd Manufacturing Co. Regarding cars, he stated "A sound policy for new freight car building would stipulate no new sizes of types or designs of railroad freight cars, except in special cases to serve defense needs." Other recommendations included, orders for 1,000 cars or less should not be placed with more than one builder, but the allocation of total requirements should be distributed equitably in large lots. So far as practicable, standard sizes and shapes of structural members should be used in building cars, thereby speeding production.

Canadian Business Cooperates Fully in Price Control System

OTTAWA—Preceded by significant last-minute changes in administrative control and by a high-powered nation-wide propaganda effort, Canada's overall price ceiling slid smoothly into prepared grooves on the first day of the month. Preliminary surveys indicated that it was being generally accepted, that business was cooperating everywhere. Necessary adjustments in price structures are being made unilaterally or by agreement to avoid arbitrary action by control authorities. Defiance of the law or attempts to evade it apparently will be rare.

Anti-inflation fever resulted in turning administration of the price roof over to Bank of Canada's Deputy Governor Donald Gordon.

Gordon quickly made it plain that he took over the job to make the ceiling work regardless of the effect on profits. He earned, however, the commendation of business men by telling them in advance what was expected. All business knew: (1) that no bulges would be permitted in the ceiling, (2) that on goods in stock at the close of business Nov. 30 each branch of business would have to absorb its own losses (3) that on replacement goods the squeeze would have to be distributed without undue hardship on the retailer, (4) that where necessary manufacturers and wholesalers would have to reduce prices on goods ordered in advance of the ceiling announcement, (5) that no "essential" business would be forced, and (6) that importers of essential materials would be indemnified against loss.

Big Business Cooperates

Heads of "big business" were called in and convinced by Gordon that failure to defeat inflation meant ruin for Canada and themselves. They agreed to accept the ceiling and sent their best propagandists and publicity men to Ottawa to help Gordon convince run-of-mine business that there was no alternative.

Metal industries escape the full force of the ceiling to the extent that they are selling a large proportion of their output to Howe for war purposes. On these sales their price structure will not be affected—but Howe is watching war costs closely.

Actually, Canadian metal-using industries are suffering more from the squeeze imposed by Washington than by Ottawa policy. Principal current headache of Canada's steel control is in meeting Washington's allocation rules on the steel which Canada needs from the U. S. next year. Ottawa hoped that Washington would take its word that the 1,800,000 tons would be used only for vital war purposes. Washington, however, insists on the same allocations on steel ordered by Canada as apply to U. S. defense users.

INSIDE DETROIT

Auto industry denies Washington reports that 70 percent of equipment can be adapted to defense. European experience no basis for assumption. Chrysler utilized 3,000 of its installed machines

BY RUPERT LEGRAND, DETROIT EDITOR

DETROIT—There has been much controversy regarding the percentage of automotive equipment which can be converted to defense production. Executives in the industry have not been willing to talk percentages. But they cautiously indicated originally that perhaps only a minor fraction of installed equipment could be retooled for defense, and that in some cases better progress might be obtained by erecting new plants and providing machinery specifically chosen for each job.

Critics insist that this was merely an effort of the industry to keep on producing automobiles. They assert that car makers concealed the fact that a much larger percentage of installed equipment can be made available for defense purposes. Washington now hears that as much as 60-70 percent of automotive facilities can be converted to munitions manufacture (see p. 1286i).

Apply European Experiences

These stories probably are based on application of experiences in England and Germany to the American problem. But the fundamental differences between auto plants in Europe and the United States have been overlooked. Smaller volume, and military expediency in Germany, dictated the use of general-purpose machine tools. Passenger-car and truck production in the United States is on a far higher plane of output, and a goodly percentage of installed equipment is of the special-purpose variety for reasons of cutting cost, speeding production, achieveing better finish and accuracy, and permitting an unskilled man to do the work of many skilled men working on general-purpose machine tools.

Surveys Useless

Neither the automobile industry nor the individual firms have sought to answer their critics. Surveys of equipment are meaningless, because Nobody knows how much defense material must be produced before peace returns, nor what share of the load must be shouldered by the automobile industry. Consideration of the use of existing equipment, furthermore must be related to a specific defense project.

Size of contract, the item, the monthly production quotas are factors that must be known before a plant can set up equipment schedules. Next follows the problem of ascertaining which machines originally installed for manufacturing "horsepower" can be converted to producing guns, tanks, shell, bombers or whatever the defense item happens to be.

No Ground of Understanding

Capacity of existing equipment must be appraised against the equipment schedule for the defense project, and only expert opinion can be accepted as to whether a given machine tool is physically capable of performing the task in mind. So many factors are involved in the setting up of a defense project that there is no common ground of understanding between automotive management and armchair critics.

These are the reasons why executives have not handed out a snap answer concerning the percentage of automotive equipment that can be utilized on defense work. What has been the experience in application of existing equipment to present contracts?

Through the courtesy of Chrysler Corp. it is possible to show what one major company has done in adapting its resources to government work. Out of 5,100 machine tools required to handle defense contracts spread throughout the Corporation's plants, approximately 3,000 were taken from existing facilities. Valued at $25,000,000, they constituted 20 percent of installed equipment. Floor space turned over to defense is worth another $10,000,000.

The 3,000 machine tools adapted to defense are high quality units capable of producing munitions to government specifications. To obtain them, Chrysler combed every manufacturing department. The process was carried to the point where standby units (machines available in case of breakdowns in car producing departments) were taken for defense work.

Planning by expert master mechanics has satisfied defense needs and also maintained the efficiency of car producing facilities operating under restricted volume.

Conversion Varies

The percentage of regular auto production equipment applicable to defense work depends upon the nature of the individual contract. At Chrysler conversion ranges from 100 percent on manufacturing problems similar to those found in automotive operations to virtually zero on work which is totally unlike anything in the automobile business. No machinery was required to make camp furnaces, field ranges and stands for propellers.

Only one machine was purchased for a shell contract. But for anti-aircraft guns, an example of distinct dis-similarity with normal business, 70 per cent of required equipment has had to be purchased. The making of aluminum forgings for bombers on the other hand required all new equipment.

Golden Years—*William Behrend and Richard F. Vacha receive gold medals from George S. Case, chairman of the board, Lamson & Sessions Co., in recognition of 50 consecutive years of service with the company. Twenty-seven employees of 25 years service were also honored at the dinner*

NAM Platform Demands One Defense Agency; William P. Witherow Elected President

NEW YORK—Centralization of administration of the national defense program in a single agency with a single head was demanded by the Congress of American Industry of the National Association of Manufacturers, which held its annual meeting last week at the Waldorf-Astoria hotel. The platform unanimously adopted by one of the largest NAM gatherings also called for an end to strikes, a check to inflation through cuts in non-defense expenditures and a tax program to finance defense, a federal sales tax, and an all-out defense effort by business.

William P. Witherow, president, Blaw-Knox Co., Pittsburgh, and chairman of the NAM National Defense Committee, was elected president of the association. He succeeds Walter D. Fuller, president, Curtis Publishing Co.

Would Eliminate Confusion

Speeding of the defense program demanded a single defense agency, according to the platform. Such a control would hold down costs and eliminate the confusion resulting from conflicting authority of the overlapping government committees.

But most of the discussion hinged around the labor situation. William S. Knudsen, Director General, Office of Production Management, told the delegates to the Congress that legislation should be passed if necessary to stop the labor foolishness.

Wages Not Issue

"In most cases of strikes, wages and working conditions were not the issue, but the usual demands for closed shops, union shops, preferential shops," Mr. Knudsen said. "I can't for the life of me understand how in a period of national emergency such foolishness like this can go on. We are in a very good position regarding wages and working conditions. We have all kinds of work to do, and then we have to stop and argue about jurisdictional disputes and organized disputes."

Industrialists were verbally spanked by the chairman of their committee on employment relations, Thomas Roy Jones, president, American Type Founders. Manufacturers, failing to recognize the facts, had gone in for wishful thinking in previous efforts to prove their case, he asserted. Calling for a change in their tactics on labor, he said, "It's all right to be dumb on occasion, but it's not right to make a career of dumbness."

Compulsory Arbitration Opposed

Plant seizures and compulsory arbitration in labor disputes were deplored by Charles R. Hook, president, American Rolling Mill Co., who said, "The sound solution is to act upon the causes of strikes before they arise; by prohibiting strikes contrary to public policy, but placing absolute prohibition only upon those contrary to public policy; and by requiring resort to peaceful methods and approval by secret ballot of a majority of the employees to be involved."

Production volume must be doubled if Hitler is going to be defeated or kept from beating everybody else, according to Donald M. Nelson, Executive Director, Supply, Priorities and Allocation Board. "We have got to show that capitalism can and will meet the requirements of a national emergency if we wish to have capitalism continue to exist," he said. "More than anything else today, we need a unity of industry and labor in this emergency."

Winning War Not End Objective

In our determination to win the war we should keep in mind that winning is not an end objective, Alfred P. Sloan, chairman, General Motors Corp., stated. "National security, the preservation of a representative democracy, with free enterprise as an instrumentality of national progress—that is what we are fighting for," he asserted.

Blame for the public apathy toward the defense emergency was laid to the Roosevelt administration by Ernest T. Weir, chairman, National Steel Corp. Pointing out that the original defense effort had been multiplied many times and there is talk of doubling the program to $120,000,000,000, he said, "Titanic though the program be, industry with proper governmental cooperation can do the job."

Need Sacrificial Leadership

If the job is to be one of those "brilliant production triumphs with which America has time and again astonished the world," he continued, "it will result if industrial management gives its heart and soul. A peaceful people with traditional freedom and independence may endorse the need for a great national effort, as the majority of Americans undoubtedly have done. However, they can be led to make the sacrifices required by such an effort only by leadership which is sacrificial."

TINY TOOLS WHIP CORROSION

EAST PITTSBURGH—The defeat of the many invisible enemies of machines—spots which mar metal surfaces and reduce efficiency—is being brought about by the "Tom-Thumb" tools of microchemistry used in the research laboratories of Westinghouse Electric & Mfg. Co. Tiny flakes of rust and tarnish are measured in millionths of ounces. Since such small amounts would be lost in ordinary chemical apparatus, tiny flasks, beakers, crucibles and test tubes are used. Acids and other liquids are handled with medicine droppers.

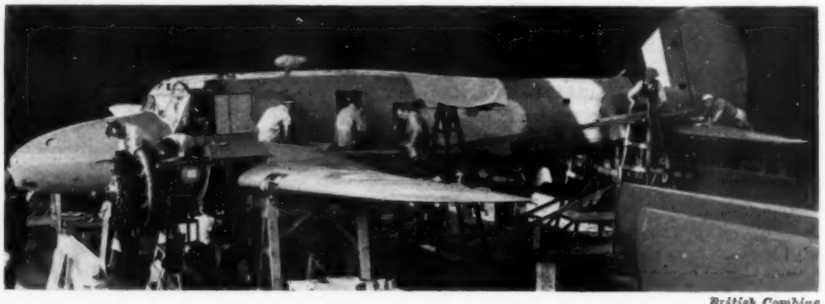
ARMY FORCED HILL'S OUSTER

WASHINGTON—For the first time, last fortnight, the War Department admitted to having forced a change in the management of a defence contractor. The department says it insisted on the ouster of F. LeRoy Hill from the presidency of Air Associates—under Army operation since October 30, as a result of labor difficulties. But it denies forcing appointment of Frederick G. Coburn the new president.

The Army gives two grounds for its action. Hill's "inability to handle labor difficulties" resulted in a stoppage of production. And his financial management had brought the company to a state where it was unable to meet its current obligations, further endangering production. To put the company's finances back in shape, the War Department advanced $500,000.

It was the second of these situations that directly resulted in Hill's leaving. As a condition of the advance, the department demanded from the board of directors "assurance of satisfactory management." The board thereupon asked for Hill's resignation.

The department attempts to give a color of normality to the situation by pointing out that it merely "took the same measures that any bank would take under similar conditions." This is small comfort to firms holding 323 contracts amounting to $5 billion on which the War Department is making advances—and potentially claiming the prerogatives of a banker.



British Combine

School Ships—*Canadian bomber pilots are trained in two-motored Avro Anson airplanes like the one above being assembled in a Montreal plant*

WATCHING WASHINGTON

Fight on over allocation of materials to small plants. Taub to test theory that 70 percent of auto industry can be converted to defense. Hint at profit scandal. Defense brokers investigated by House.

BY BLAINE STUBBLEFIELD

WASHINGTON—Despite Donald Nelson's rejection of the Floyd Odlum plan arbitrarily to allocate a fixed percentage of scarce materials to small (less than twenty workers) plants (*AM*, Vol. 85, p. 1236c), heavy pressure is building up behind it. Senate naval committee is holding hearings on a bill by O'Mahoney which would set up a board to which small business could appeal for materials. This bill in itself is not taken seriously, but agitation for it increases the heat on the Office of Production Management.

Nelson's solution is to set up a pool of material and allocate it to the places where a pound of material will create the most employment. This would not necessarily be in the smallest plants. The scheme has logic but will not still the cries of anguish.

Meanwhile, Director Floyd Odlum of the Contract Distribution Division is fighting for his scheme. He sees it as a temporary thing to tide over the difficult months ahead when materials are scarce and plans for enlisting small businesses in defense production have not yet matured. There are some 40,000 metal-working plants, he says, that are going to be hard hit by priorities in the immediate future.

Conversion Section Created

Bolder conversion of manufacturing facilities to defense work—particularly in automotive industries—may result from the creation in Odlum's CDD of a new conversion section headed by Alex Taub, British-American automotive engineer. Taub has been startling Washington acquaintances lately by telling them that 70 percent of existing auto manufacturing machinery can be converted to defense production. Last Spring, when the Reuther plan for converting auto plants was a hot issue, the industry and Knudsen put the figure nearer 15 percent. Now Taub has been told to prove out on his theories. He is a protege of Sidney Hillman—ardent supporter of the Reuther plan—and recently has been a special consultant to the Labor Division.

Profit Hearings Start Soon

Hearings will begin soon on Vinson's 7 percent profit limitation bill. Vinson's defense investigation committee has employed numerous highly-skilled auditors from the Army and Navy to peer into big manufacturers' books and War and Navy Department accounts. Persons *in the know* say some disturbing instances of exhorbitant profits, particularly in the airplane field, have been dug up.

One company is reported to have earned over 100 percent on investment. Extravagant expenses for promotional work will be brought out in testimony. Although the committee is withholding its facts thus far, it is believed that most of the answers to its deluge of questionnaires must be in by now.

"Defense Brokers" in Spotlight

"Defense brokers" have done well enough in Washington that they are about to get themselves investigated by the House Military Affairs Committee. Committee members say these agents collect large commissions, and that they are doing it on the claim of, and in some cases actual use of, "influence." The Committee is calling on a number of manufacturer witnesses who have paid the commissions.

Investigation by this magazine reveals that not all agents for contractors are bad. In some cases they sell their services solely on the ground that they know how to get around the Capital's red-tape entanglement and to accomplish in a few days what would take a stranger weeks to do.

Seek Settlement for Welders

A labor situation likely to have a wide effect on the metal-working industries has arisen out of the position of welders in the AFL unions. At present, they are split up among five or six unions. Thus a welder often has to pay dues to two or three unions. In protest many welders formed an independent union, sought an AFL charter. This was refused, and protest strikes resulted.

Last month it appeared that a partial solution had been reached when the Office of Production Management obtained an agreement from the Metal Trades Department of AFL that welders in shipyards need carry only one card. However, owing to the grudging way in which AFL worked out details, the welders rejected this settlement.

Current efforts at a settlement are centered on a series of meetings being held on the West Coast between shipbuilders and AFL officials. Out of these meetings, OPM hopes to get a one-card scheme which the welders cannot refuse. Any solution arrived at in the shipyards will undoubtedly extend rapidly to all the AFL-organized industries employing welders.

OPA Opposes Escalators

Use of escalator clauses in pricing machinery for future delivery is opposed, in principle, by the Office of Price Administration. It feels that by basing price on the cost factors at the time of delivery rather than during the whole period of production, such a clause tends to make prices rise faster than costs. Moreover, it is believed to have a psychological effect similar to a cost-plus contract—to make producers careless about holding costs down. Where ceiling prices have been imposed, OPA suggests instead the contract be written to make the price fluctuate with any changes in the ceiling.

OPA also urges that when prices of a manufacturers line have to be increased, the increase be concentrated on the low-volume models, so as to encourage customers to buy low-cost standardized machines.

Few Ocean Lanes Can Be Cut

Reports that OPM is making a survey to determine just what the raw materials situation would be if ocean trade routes were severed, are not quite accurate. First, there is no possibility of routes being cut except to the far East; Japan has a moderately strong navy, but the Germans do not. Rubber and tin would be the principal losses if lines to the East were cut.

The rubber problem would be very serious. Tin would be serious too. But 60 percent of consumption goes into tin plate and solder. We could practically stop production of tin cans, supply preserved foods in glass. Silver could be substituted for tin in many applications.

SOLDIERS MAY WEAR ARMOR

WASHINGTON—Armor plate for individual soldiers, somewhat after the manner of the ancient Greeks and Romans, is reported perfected by the British. It affords good protection against tommy gun and pistol fire at point blank range, and against shell splinters and glancing rifle and machine gun fire. According to Army and Navy *Journal*, the armor is in three pieces: chest-abdomen and leg plates which, including padding, weigh about three pounds. Ordnance sources told AMERICAN MACHINIST it is a safe statement that the U. S. Army is experimenting with personal armor.

U. S. Government Contracts Awarded to Metal-Working Firms

(Does not include contracts under $10,000)

Source	Agency	Commodity	Amount
Steel Products Engineering Co., Springfield, Ohio	War	Machine gun turrets	$8,611,416
Thompson Products Inc., Cleveland, Ohio	"	Fuel pumps	1,461,075
Jack & Heintz, Inc., Cleveland, Ohio	"	Equipment assemblies	4,525,650
S. Morgan Smith Co., York, Pa.	"	Turbines, accessories	1,134,801
General Motors Corp., Chevrolet Div., Flint, Mich.	"	Trucks, 1½ ton	594,981
International Harvester Co., Ft. Wayne, Ind.	"	Trucks, 2½ ton	744,944
Bell Aircraft Corp., Buffalo, N. Y.	"	Airplane parts	1,358,943
Fairchild Aviation Corp., Jamaica, N. Y.	"	Cameras	1,919,897
Bendix Aviation Corp., Bendix, N. J.	"	Starter assemblies	3,434,735
War Supplies, Ltd., Washington, D. C.	"	Propeller blades	525,000
General Electric Co., Schenectady, N. Y.	"	Transformers	496,839
Teletype Corp., Chicago, Ill.	"	Teletype sets	1,594,730
Curtiss-Wright Corp., Caldwell, N. J.	"	Propeller assemblies	656,880
Curtiss-Wright Corp., Buffalo, N. Y.	"	Airplane parts	861,620
Butler Mfg. Co., Kansas City, Mo.	"	Portable hangars	445,320
General Motors Corp., Detroit, Mich.	"	Shot	35,705,287
Union Fork & Hoe Co., Columbus, Ohio	"	Bayonets	548,049
American Type Founders, Inc., Elizabeth, N. J.	"	Gun parts	715,043
General Motors Corp., Lansing, Mich.	"	Guns	2,768,300
Fedders Mfg. Co., Buffalo, N. Y.	"	Metallic belt links	2,319,974
Potter & Johnston Machine Co., Pawtucket, R. I.	"	Chucking machines	536,910
Cleveland Automatic Machine Co., Cleveland, Ohio	"	Machines	528,440
Chain Belt Co., Milwaukee, Wis.	"	Guns	2,396,000
Chicago Flexible Shaft Co., Chicago, Ill.	"	Feed mechanisms	636,988
Munitions Mfg. Corp., Poughkeepsie, N. Y.	"	Guns	4,266,000
Duplex Printing Press Co., Battle Creek, Mich.	"	Gun carriage parts	1,443,000
Bullard Co., Bridgeport, Conn.	"	Lathes	593,300
Landis Tool Co., Waynesboro, Pa.	"	Grinding machines	621,054
Iowa Transmission Co., Waterloo, Iowa	"	Transmissions	9,842,000
Parish Pressed Steel Co., Reading, Pa.	"	Gun carriage parts	701,935
Aetna Standard Engineering Co., Youngstown, Ohio	"	Spring rammers	2,523,056
Cummins Diesel Electric Co., New York, N. Y.	"	Generators	604,910
International Diesel Electric Co., Long Island City, N. Y.	"	Generators	546,247
Continental Motors Corp., Detroit, Mich.	"	Engines	5,087,284
Westinghouse Electric & Mfg. Co., Mansfield, Ohio	"	Shot	2,336,450
Bethlehem Steel Co., Bethlehem, Pa.	"	Projectiles	657,900
Noblitt-Sparks Industries, Inc., Columbus, Ind.	"	Ammunition	791,648
General Motors Corp., Lansing, Mich.	"	Guns	2,278,000
Sipp-Eastwood Corp., Paterson, N. J.	"	Pneumatic presses	484,070
General Motors Corp., Lansing, Mich.	"	Ammunition	3,105,000
Crucible Steel Co., Harrison, N. J.	"	Ammunition	3,144,582
Motor Wheel Corp., Lansing, Mich.	"	Ammunition	1,505,000
Auto Ordnance Corp., Bridgeport, Conn.	"	Magazines	532,646
Wheland Co., Chattanooga, Tenn.	"	Guns	9,067,270
Mergenthaler Linotype Co., Brooklyn, N. Y.	"	Range quadrants	1,030,128
Mergenthaler Linotype Co., Brooklyn, N. Y.	"	Telescope mounts	857,619
Autocar Co., Ardmore, Pa.	"	Track parts	989,400
Eaton Mfg. Co., Cleveland, Ohio	"	Ammunition	2,355,000
Armstrong Cork Co., Lancaster, Pa.	"	Shell	782,467
Easy Washing Machine Co., Syracuse, N. Y.	"	Fuzes	750,000
Lockheed Aircraft Corp., Burbank, Calif.	"	Airplane parts	10,966,152
The Trailer Co., Cincinnati, Ohio	"	Semi-trailers	1,759,065
Butler Mfg. Co., Kansas City, Mo.	"	Portable warehouses	1,649,476
American Type Founders Co., Elizabeth, N. J.	"	Tools, machinery	495,000
Western Cartridge Co., New Haven, Conn.	"	Rifles	5,791,200
Nineteen Hundred Corp., St. Joseph, Mich.	"	Machine gun mounts	4,322,120
Easy Washing Machine Corp., Syracuse, N. Y.	"	Machine gun mounts	4,322,120
General Motors Corp., Lansing, Mich.	"	Guns	2,350,000
Guiberson Diesel Engine Co., Chicago, Ill.	"	Engines	2,455,301
International Harvester Co., Chicago, Ill.	"	Tractors	965,985
Gibson Electric Refrigerator Co., Greeneville, Mich.	"	Ammunition chests	604,782
Minneapolis Moline Power Implement Co., Minneapolis, Minn.	"	Shell	805,200
General Motors Corp., New York, N. Y.	"	Hardware	478,774
Dresser Mfg. Co., Bradford, Pa.	"	Shell	962,500
Independent Engineering Co., Inc., Fallon, Ill.	"	Oxygen cylinders	829,309
U. S. Pipe & Foundry Co., Birmingham, Ala.	"	Shell	694,572
Indianapolis Drop Forging Co., Indianapolis, Ind.	"	Shot	1,800,500
Stamford Rolling Mills Co., Springdale, Conn.	"	Disks	1,028,595
The Rauland Corp., Chicago, Ill.	"	Transmitters	453,112
Westinghouse Electric & Mfg. Co., Dayton, Ohio	"	Regulators	632,500
Bendix Aviation Corp., Bendix, N. J.	"	Airspeed indicators	802,200
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.	"	Periscopes	1,041,579
Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.	"	Periscopes	1,934,361
National Tube Co., Pittsburgh, Pa.	"	Demolition bombs	4,141,500
Robertshaw Thermostat Co., Youngwood, Pa.	"	Boosters	1,720,800
General Motors Corp., New York, N. Y.	"	Hardware	418,014
General Steel Castings Corp., Eddystone, Pa.	"	Carriage shields	2,600,000
Continental Roll & Steel Foundry Co., E. Chicago, Ind.	"	Armor shields	1,687,000
Remington Arms Co., Inc., Bridgeport, Conn.	"	Rifles	9,808,800
Utica Cutlery Co., Utica, N. Y.	"	Bayonets	794,000
National Stamping Co., Detroit, Mich.	"	Metallic belt links	2,665,900
Air Cruisers Inc., Clifton, N. J.	"	Oxygen cylinders	1,047,592
The Bullard Co., Bridgeport, Conn.	"	Turret lathes	593,300
General Motors Corp., Dayton, Ohio	"	Screw machines	1,359,720
Chandler-Evans Corp., S., Meriden, Conn.	"	Fuel pumps	1,320,877
Nehring Electric Works, DeKalb, Ill.	TVA	Copper conductors	428,400
Phelps Dodge Copper Products Corp., New York, N.Y.	Int.	Conductors	885,294
Anaconda Wire & Cable Co., New York, N. Y.	TVA	Copper conductors	535,500
Wells-Gardner & Co., Chicago, Ill.	War	Radio receivers	1,443,247
Zenith Radio Corp., Chicago, Ill.	"	Meters	1,500,338
Nash-Kelvinator Corp., Detroit, Mich.	"	Propellers	19,503,878
Candler-Hill Corp., Detroit, Mich.	"	Fuel pumps	820,900
Grumman Aircraft Engine Corp., Bethpage, N. Y.	Treas.	Airplanes	424,305
Bendix Aviation Corp., Bendix, N. J.	War	Regulators	2,208,450
Fargo Motor Corp., Washington, D. C.	"	Trucks	659,087
Sperry Gyroscope Co., Inc., Brooklyn, N. Y.	"	Pilot units	781,524
Bendix Aviation Corp., Bendix, N. J.	"	Compasses	2,451,000
Manning Maxwell & Moore Inc., Bridgeport, Conn.	"	Gages	628,320

Olds Spending $8,000,000 For Equipment to Make Guns

DETROIT—Oldsmobile Division, General Motors Corp., will spend approximately $8,000,000 on machines and machine tools to be used in the manufacture of 75 mm. guns for the Army Ordnance Department. In announcing the recent government authorization, Olds General Manager S. E. Skinner did not disclose the value of the order or the number of guns to be manufactured, but did say that the award exceeded all previous defense orders received by the company.

The three principal parts—barrel, breech ring and block—will be manufactured at the Olds plant, while the other 67 parts will be sub-contracted to outside companies. Although it appeared that no outside help would be required, Mr. Skinner announced that men who would be laid off due to curtailment in automobile production will be employed. A special program is being launched to train automobile workers for job of gun manufacturing.

DEFER FOIL ORDER 30 DAYS

WASHINGTON—Faced with protests of Reynolds Metal Co., principal producer of metal foils, the Priorities Division of OPM has deferred for thirty day an order which would have prohibited most packaging-use of lead or tin foil after March 15. Manufacture of foils for packaging tobacco, candy and a number of other products would have been cut by two thirds immediately and forbidden after the end of the year. OPM will re-study the order during the thirty-day period. Reynolds has had a good deal of influence in Washington ever since predicting the aluminum shortage at a time when the Defense Commission was still saying there was plenty.

DISTRESS AREAS GET CONTRACTS

WASHINGTON — Defense contracts totaling $31,577,090 have been awarded by the Army and Navy in areas where the Office of Production Management has found shortages of material for non-defense work causing grave unemployment. Thirty-seven companies in seven of the ten areas, and the one industry, which were certified to the armed forces as distress areas, received contracts. Some 100 areas facing priorities unemployment are under study by the Contract Distribution and Labor Divisions of OPM for further certification.

LINDBERG FILMS HEAT-TREATING

CHICAGO—A 40-minute sound and color movie "Heat-Treating Hints" has been filmed by the Lindberg Engineering Co., in collaboration with the Lindberg Steel Treating Co. Covering

straightening methods, torch spotting, tools and suggestions on quenching, the movie will be released soon for training and educational purposes.

NAMES in the NEWS

Dr. Johan Bjorksten has been appointed director of laboratories, the Quaker Chemical Products Corp. He was formerly chief chemist for the Felton Co., the Pepsodent Co. and Ditto, Inc.

C. E. Herington has been appointed sales director of the newly created sales service department established by the Meehanite Research Institute of America, Inc. Formerly advertising manager, Mr. Herington will continue to supervise Meehanite promotional activities.

H. A. Hudson, formerly manager, Motor Sales Div., Wagner Electric Corp., has been promoted to the position of manager of sales, Electrical Div. He joined the company in 1924. O. V. Greene, assistant metallurgist has been named manager of tool steel sales. Prior to joining the company in 1928, he was metallurgist with the Reading Railroad Co.

R. C. McKinney, formerly with the Pratt & Whitney Aircraft Div., United Aircraft Corp., has been named superintendent, aircraft bearing plant, Cleveland Graphite Bronze Co.

James D. Mooney, vice president and director, General Motors Corp., has been ordered to active duty in the U. S. Navy. Beginning Jan. 1 he will head the Production Engineering Section, Bureau of Aeronautics. He had been chairman of the company's Defense Materials Relationships Committee.

Harold C. Richardson, assistant superintendent Syracuse Plant, Porter-Cable Machine Co., is on an extended leave of absence to fill a position in the New York City office, Contract Distribution Division, Office of Production Management.

Carpenter Sales Head

R. V. MANN

GE Vice-President

T. I. PHILLIPS

R. V. Mann, who since 1925 has been assistant to the president, The Carpenter Steel Co., has been named general sales manager.

D. E. Ralston, associated with the General Motors Corp. since 1918, has been promoted to manager of automotive operations, Oldsmobile Division. R. E. Griffin, becomes manager of Defense Operations, while H. A. Trevellyan has been named general sales manager. Mr. Griffin will be assisted by R. L. Myers, F. Q. Murphy, and W. O. Lampe.

T. I. Phillips, assistant to the president since February, was recently elected a vice president, Westinghouse Electric & Manufacturing Co. He started in the company as a tool maker in 1915 and within a year became foreman. He advanced through many positions until he became works manager in 1930. He held the latter position until February of this year.

Brigadier General John B. Rose has been transferred from command of the Picatinny Arsenal, Dover, N. J., to duty in the office of the Chief of Ordnance, Washington D. C. Colonel William E. Larned replaces Brig. Gen. Rose at Picatinny. He had been chief of the Arnenal's manufacturing division.

Joseph A. Sullivan has been promoted from assistant publicity manager to advertising manager, Chicago Pneumatic Tool Company.

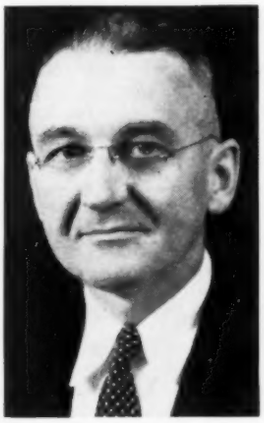
Alex Taub, who has been a special consultant on technical problems for Office of Production Management's Associate Director Sidney Hillman, has been named chief, Conversion Section, Contract Distribution Division of OPM.

George Tharratt has been appointed chief engineer, Adel Precision Products Corp., Burbank, Calif. For the past three years, Mr. Tharratt has been head of the production illustration department, Douglas Aircraft Company. Lynn Reynolds, former chief engineer, has been appointed vice-president and production manager.

O. W. Young, formerly general manufacturing manager, Buick Motor Division, General Motors Corp., has been named executive assistant to General Manager Harlow H. Curtice in charge of all manufacturing. W. M. Larke, general superintendent, becomes manager of manufacturing in charge of all Flint, Mich., operations. Former Assistant General Superintendent B. H. Newell is general superintendent in charge of automobile production. He is succeeded by A. R. Middleton, former superintendent of the sheet metal plant. James Langford takes over the latter position. Other changes in the manufacturing organization are: Fred

Involved in Buick Management Shifts

W. M. LARKE



FRED PYPER

B. H. NEWELL

Letts, general superintendent of all defense production in Flint; Fred W. Moore, assistant general superintendent of defense operations, Norman Hervey, superintendent of the toolroom; John A. Holik in charge of tank manufacture; and Carl A. Savage, assistant superintendent of the axle plant.

PLANT EXPANSION

Ampco Metals, Inc., Milwaukee, Wis., is launching an $830,000 expansion program. A $275,000 addition to its bronze foundry was dedicated Nov. 14, while work was progressing on a $250,000 machine shop addition.

The Defense Plant Corp., subsidiary of the Reconstruction Finance Corp., has authorized the following lease agreements for plant and machinery expansion:

Bay State Tap and Die Co., Mansfield, Mass., $36,913.
Bendix Aviation Corp., South Bend, Ind., $128,180.
Boeing Airplane Co., Seattle, Wash., $128,900.
Chandler-Evans Corp., Dayton, Ohio, $1,145,127.
The Cleveland Graphite Bronze Co., Cleveland, Ohio, $1,393,647.
Extruded Metals Defense Corp., Grand Rapids, Mich., $6,615,761.
General Electric Co., Fort Wayne, Ind., and Philadelphia, Pa., $774,735.
Genesee Tool Co., Fenton, Mich., $154,000.
Gus Reimke Machinery & Tool Co., Newark, N. J., $120,620.
Houde Engineering Corp., Buffalo, N. Y., $731,000.
Kilby Steel Co., Anniston, Ala., $40,000.
National Wire Die Co., New York, N. Y., $9,000.
Scott & Williams, Inc., Laconia, N. H., $609,331.
Superior Steel Products Co., Monaca, Pa., $225,000.
Tincu Forging Die & Tool Co., Chicago, Ill., $32,430.
Vickers, Inc., Detroit, Mich., $8,590,957.
Wellman Bronze & Aluminum Co., Cleveland, Ohio, $110,072.
Youngstown Sheet & Tube Co., Youngstown, Ohio, $1,900,000.
Wayne Wire Die Co., Hillside, N. J., $6,000.

National Supply Co., Torrance, Calif., will erect a $265,000 forge and machine shop building adjoining its present plant. Part of a $2,300,000 expansion program, the new building will be completed at the end of this year.

Pacific Bridge Co., San Francisco, Calif., has leased the Thomas Machine Works, at Los Angeles Harbor, and will enlarge it for production work on steam engines and other gear for freighters planned by the United States Maritime Commission.

Phelps-Dodge Copper Products Corp. will construct a 750x250 ft. condenser-tube plant in Los Angeles, Calif.

Quaker Chemical Products Corp., Conshohocken, Pa., has broken ground for a new two-story manufacturing plant totaling 40,000 sq. ft.

Solar Aircraft Co., San Diego, Calif., has purchased the plant of the Potter Radiator Co., at National City, Calif., and will convert it into a factory for producing airplane exhaust manifolds and other aircraft parts.

Star Engineering Co. is erecting a $6,500,000 shipyard with seven ways on Rough and Ready Island, west of Stockton, Calif.

The Denison Engineering Co., Columbus, Ohio, has begun construction of a new plant, to provide 50,000 sq.ft. of floor space for manufacturing activities.

Western Gear Works will build a new factory and office building at Imperial Highway and Alameda St., Lynwood, Calif., at a cost of $130,000.

BUSINESS ITEMS

Burndy Engineering Co., Inc., has changed its address to 107 Eastern Blvd., New York, N. Y. The former address was 459 East 133rd St.

Keystone Carbon Co., has opened an eastern sales office at 249 High St., Newark, N. J. Robert McKeown and Charles V. Allen are district representatives. The company also has appointed A. A. Barbera & Co., 417 South Hill St., Los Angeles, Calif., as representative in the Southern California territory.

Lincoln Electric Co., has appointed J. M. Chapple, manager of a newly opened office at 700 East Union St., Jacksonville, Fla.

Progressive Welder Co., has appointed W. P. Childs, 845 Memorial Drive, S. E., Atlanta, Ga., as representative in that area.

Reliance Electric & Engineering Co., has purchased the plant of the Cleveland Hobbing Machine Co. The latter company will shortly move its operations into a new plant at Euclid, Ohio.

The Sterling Grinding Wheel Div., The Cleveland Quarries Co., Tiffin, Ohio, has opened a warehouse at 2066 Random Rd., Cleveland, Ohio.

Western Machine Co., Milwaukee, Wis., celebrated its 25th anniversary Oct. 20.

OBITUARIES

Matthew J. Esser, 66, former secretary-treasurer, Fuller & Johnson Co., Madison, Wis., died Nov. 16. He joined the company in 1893 and retired in 1931.

Harry C. Gowran, 70, president, Hamilton Manufacturing Co., Two Rivers, Wis., died Nov. 21.

G. W. Gressenbach, 90, vice president, Bradley Wash Fountain Co., Milwaukee, Wis., died Nov. 8.

D. W. Hudson, 76, former president, Hudson-Sharp Machine Co., Green Bay, Wis., died recently from burns sustained at his cottage near Tigerton, Wis. He served as head of the company from the time of its incorporation in 1910 until his retirement a few years ago.

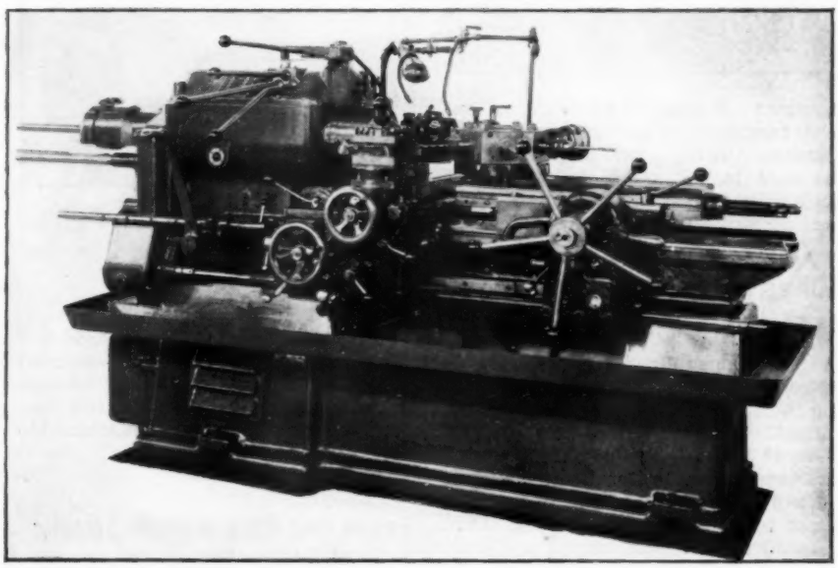
Mrs. Agnes Gordon Tack Hilton, wife of Mr. Elstner Hilton, special representative, E. C. Atkins & Co., was killed in an automobile accident, Nov. 14, near Farmington, Conn. Mr. Hilton who for many years was foreign representative of E. C. Atkins suffered minor injuries.

Stuart Judson Marble, 71, manager, Industrial Department, New York District Sales, Revere Copper & Brass, Inc., died after a brief illness Nov. 24. In 1912 he joined the New York Office of the Rome Brass & Copper Co. which in 1928 was consolidated with five other companies to form what ultimately became Revere Copper & Brass, Inc.

New Tool Plant—*This plant of J. L. Lucas & Son, Inc., Fairfield, Conn., manufacturers of machine tools, was completed recently. A 10-ton traveling crane operates over the whole length of the plant, with small gantry and job cranes in strategic locations for efficient material handling*

SHOP EQUIPMENT NEWS

Merritt No. 4 Turret Lathe Has Automatic Chuck, Bar Feed; Master Collet Takes Bushings



Merritt Engineering and Sales Co., Inc., Lockport, N. Y., has introduced its turret lathe No. 4 with automatic chuck and bar feed. These are operated by the long lever in front of the bed. With one movement, the operator opens the chuck and feeds the bar. A stepped wedge, operating the chuck closing fingers, automatically compensates for slightly varying diameters of work. The chuck has a master collet in which collet bushings for different sizes and shapes of stock can be attached.

Spindle has 12 speeds from 55 to 715 r.p.m. Three levers, marked A, B and C, are used for obtaining the speeds through sliding gears mounted on spline shafts. The sub-base is of new design and insures rigidity in alignment of machine as well as providing for mounting motor under headstock. Cross-slide on plain models has a longitudinal adjustment of 21 in. and cross-travel of 10 in. This carriage is equipped with round front toolposts and cutting-off toolpost in rear of standard equipment.

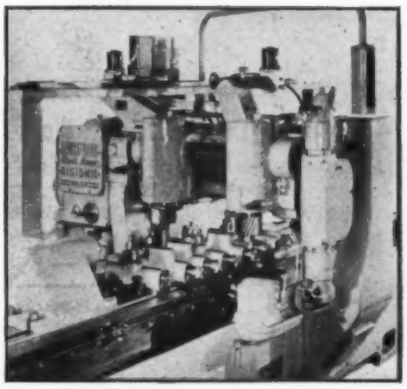
Universal carriage, reversible in the apron, has six feed changes for cross and longitudinal feed, and an additional range of six obtained through the gear box at the headstock. Longitudinal travel is 24 in. and cross travel 11 in. Carriage is regularly furnished with a square turret toolpost. Turret slide is operated by a turnstile, rack and pinion. Its hexagon turret revolves upon a steel seat to which it is clamped by an automatically operated double bevel clamp. It has 12 feed changes. Maximum distance from turret face to end of spindle is 32 in.

Thread chasing and taper attachment can be furnished. The former of the leader and nut type is used for chasing English or metric threads. One leader and nut will cut four threads in the ratios 1 to 1, 1 to 2, 1 to 3 and 1 to 4. Taper device turns tapers up to 3 in. per ft. and 8 in. long. Plain machine weighs 4,500 lb., and machine equipped with universal carriage weighs 4,800 lb.

Propeller Blade Edges Milled By Sundstrand Machine

A machine for milling the edges of propeller blades has been specially designed by the Sundstrand Machine Co., 2561—11th St., Rockford, Ill. It is built around the company's fluid screw Rigidmil. In order to mill both sides of the blade simultaneously, the machine is provided with two vertical type spindle heads mounted on a cross-rail. Their movement along the rail is controlled by a screw driven by a fluid motor.

Attached to the machine table is a two-sided cam on which duplicator "fingers" ride. This hydraulic duplicator controls the fluid motor. As the table feeds longitudinally, the duplicator actuates cross movement of the heads to transfer the desired shape to the part.

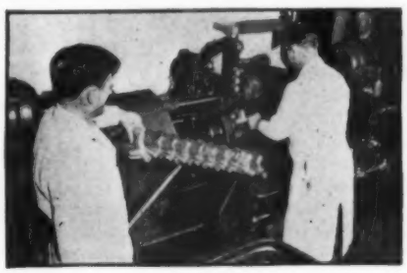


The part is held on the machine table between a headstock and a footstock and is supported at intermittent points by jacks. Using spiral milling cutters, spindles are arranged to rotate so that the cutting thrust is down against the jacks. Cycle of the machine is fully automatic. The machine has a power feed travel of 90 in. The rate of feed ranges from ½ to 38 in. per min.

Merz's Track Link Borer, Driller Adaptable to Other Industrial Uses

Automatic boring and drilling machine, designed and built by Merz Engineering Co., 200 S. Harding St., Indianapolis, Ind., automatically drills, reams, spot faces and countersinks track links used in articulated track assemblies for gun tractors and artillery tanks. These machines may be adapted for finishing holes in parts which can be loaded in similar fixtures. The present design, which is automatic except for loading and unloading, drills holes in track links 12, 15 or 18 in. long.

The 12 in. links have one hole 6 in. long parallel with two others 3 in. long. The next size have two holes 3½ in. long and one 1½ in. long parallel with two of the 3¼ in. links. The third unit drills 2 in., 3 11/16 in. holes,

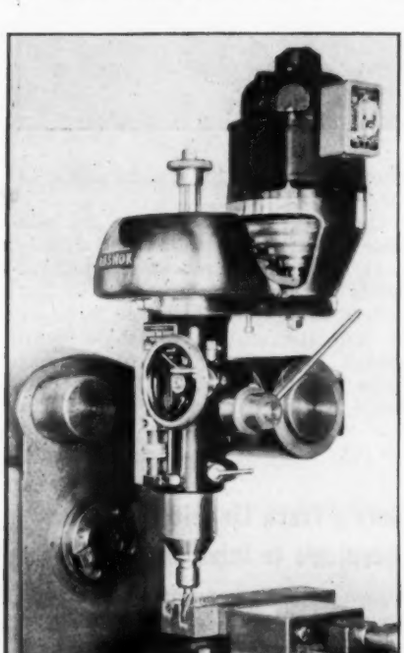


and one of 2½ in. which is parallel with two 4 in. holes.

Entire operation after set-up has been completed is controlled by a pressure bar which must be grasped by both hands of the operator before machine will begin its cycle. This bar is so located, about 3½ ft. high, that hands cannot be in the way of the machine during operation. The assembled machine, weighing 8½ tons, is approximately 14 ft. long, 8 ft. deep, and 7 ft. high.

Milling Head Designed by Rusnok For Heavy-Duty End Mill Work

A Model ST vertical milling head attachment was recently introduced by Rusnok Tool Works, 1841–45 West Carroll Ave., Chicago, Ill. Designed for



heavy-duty end mill operations, the attachment is equipped with a ½ hp. motor for eitner 110 or 220 volt a.c. operation. Quill has a 4 in. travel and a ½ in. end mill holder. Six spindle speeds from 250 to 3,000 r.p.m. are provided through aluminum pulleys. Spindle is 21½ in. long.

AC Devices Makes Equipment To Ease Welding of Thin Metals

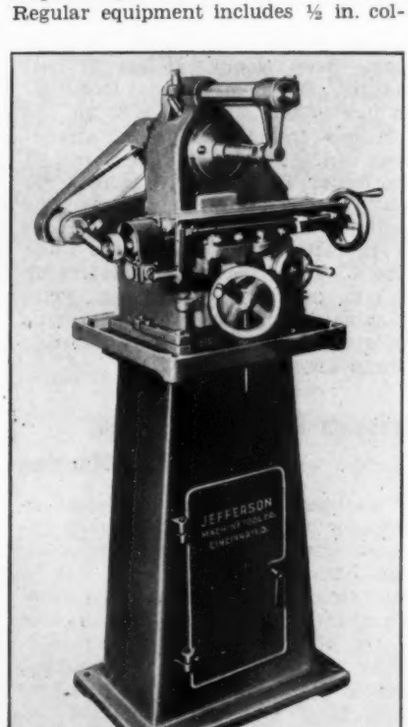
Very thin metals can be welded without danger of burning through by using the Cold Arc equipment put out by the A C Devices Co., 910 W. Van Buren St., Chicago, Ill. Better welds, lower current costs and increased production are placed for cold arc equipped a.c. welders.

Operators have little difficulty striking and holding an arc and running a good bead. With the ionizer the arc is carried over and being at high tension ionizes or burns out the oxygen-

nitrogen air mass in its path, so that less resistance is offered to the arc's passage. Thus, lower amperages can be used in soft metal welding. The ionizer operates on 110-120, 60-cycle, a.c. current at 1/10 amp.

Milling Machine Manufactured In Floor, Bench Models by Jefferson

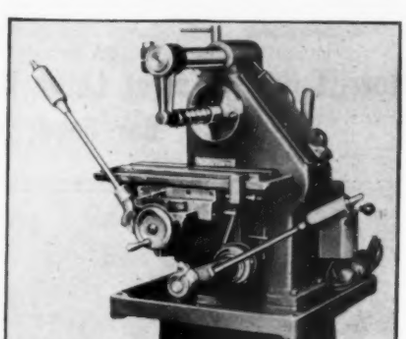
A precision milling machine recently introduced by Jefferson Machine Tool Co., 4th, Cutter and Sweeney Sts., Cincinnati, Ohio, is manufactured in floor base or bench-type models with hand or power feed. Working surface is 14 x 43/8 in. Longitudinal and transverse feeds of table are 7 and 3 in., respectively. Vertical travel is 5¾ in. Regular equipment includes ½ in. col-



Precision milling machine with power feed made by Jefferson in floor base model. Three spindle speeds are provided

let and ⅓ hp., 1,750 r.p.m. motor which provides three spindle speeds of 400, 800 and 1,200 r.p.m.

Swivel vise is 7 in. long with jaws 1⅛ in. deep by 3¾ in. wide. Jaws open two inches. The vise is graduated to obtain the full range up to 360 deg. Plain vise with jaws of similar dimen-



Jefferson hand feed miller. Levers allow longitudinal feed of 7 in. and cross feed of 3 in.

sion is 5½ in. long. Dividing head is 6 in. in diameter. Spindle is equipped with a No. 2 Morse taper, and its nose is 1⅛ in. diameter. Vertical head converts horizontal milling machine to vertical milling machine.

Empco Unit Uses Multiple Spindle Heads or Milling Attachments

The Model E Empco Unit recently improved by Enterprise Machine Parts Corp., 2731 Jerome Ave., Detroit, Mich., can be used with multiple spindle heads or milling attachments. Lead screw provides controlled tapping.

Motor brackets will accommodate any standard motor mounted at the rear or above the unit. A screw adjusting type sub-base is provided to give micrometer adjustment to the outward position of the tool. The unit comes in four sizes with maximum stroke lengths of 2½, 3, 5½ and 8½ in. Model A positive alignment hand-operated punch presses have been developed by Leslie Welding Co., 2943 Carroll Ave., Chicago, Ill. The press has a 6 in. throat and takes dies up to 4x4½ in. as standard. In special cases, however, larger dies can be used.

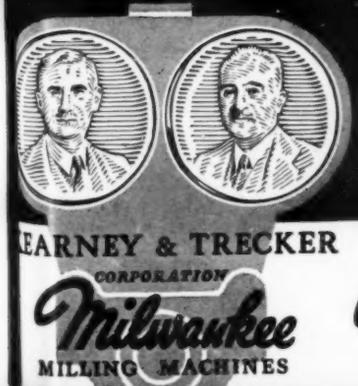
Capacity of the press is a 2 in. diameter hole in 10 gage mild steel. Universal aligning provides accuracy to 0.0001 in. The cam, 5 in. long by 3 in. in diameter, prevents lateral rocking of punch plate. This non-rocking feature makes possible punching of half holes or notching.

Unchanging . . IN A SWIFTLY CHANGING WORLD

During this crisis that threatens man and his civilization, it is more important than ever to return to the spirit of kindliness and good will which is Christmas . . . . .

It is well to remember, too, that this Christmas spirit has survived the wars and strife of the ages—it is unchanging in a swiftly changing world. Let us be strong in our faith that the Christian ideal of "peace on earth—good will toward men" may be the shining light that will lead humanity to a better world tomorrow.

Theodore Decker

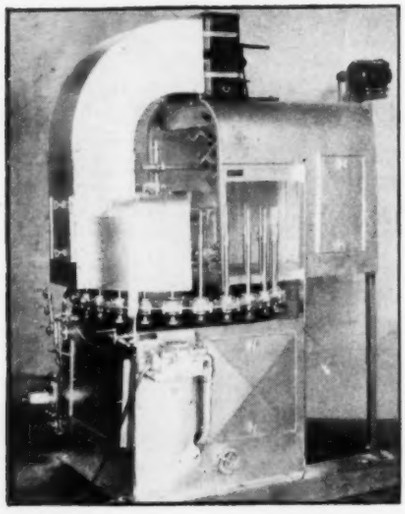


KEARNEY & TRECKER CORPORATION
Milwaukee MILLING MACHINES

Milwaukee MILLING MACHINES

Eclipse Introduces Automatic Spray Machine for Small Shell

An automatic spray machine to coat and dry the outside of small shell (20 to 40 mm.), grenades, shot or boosters have been built by the Eclipse Air Brush Co., 400 Park Ave., Newark, N. J. Shell or other pieces are carried



on indexed spindles to a position in front of automatic spray guns in a booth equipped with exhaust fan. After coating, shell pass through a small oven opposite spraying booth. A unit heater with a blower fan insures rapid drying so that shell can be removed manually as they emerge. The unit occupies a floor space 4x4 ft.

Automatic Time Control Offered On Pier's Spot Welding Machines

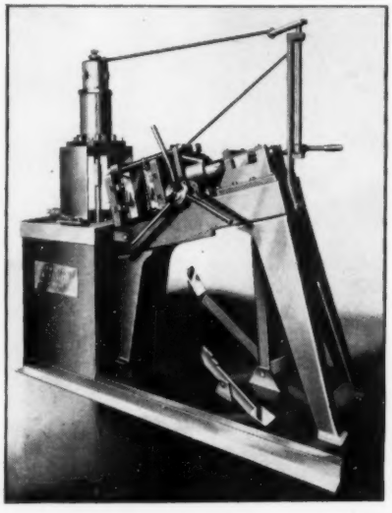
A precision timer for automatically controlling the welding time period is being offered on spot welders manufactured by the Pier Equipment Mfg. Co., Milton and Cross Sts., Benton Harbor, Mich. Welding time can be quickly selected from 3 to 47 cycles (3/60ths to 47/60th of a second), in one cycle steps. Increased production and uniform welds are assured.

In operation, after setting timing dial, operator simply feeds the work through the welder and actuates foot pedal. This closes the welder contactor which energizes the circuit and timing element. At the end of the selected time, the contactor is automatically tripped and the circuit opened.

B-K Diecaster Makes Small Units At Rate of 350 "Shots" Per Hour

Small castings that do not require exceptional finish can be run as high as 350 to 400 "shots" per hour on the Model 200 die caster announced by Burroughs-Kahn Co., 1239 South Bend Ave., South Bend, Ind. Fast changing of dies while machine is hot makes it economical to run as few as several hundred pieces. For relatively simple castings, universal die mounting blocks can be arranged for further simplification.

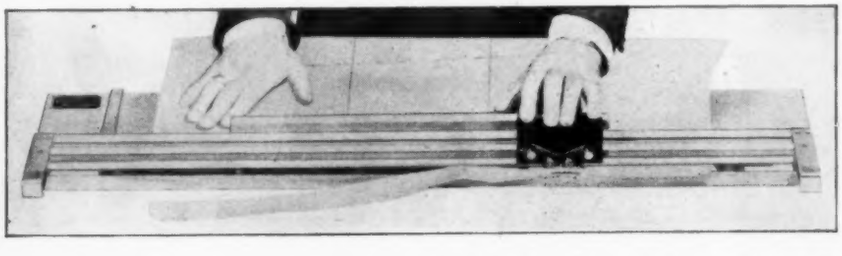
Die space between bores is 11½ in.



Mounting plates are 10x14½ in., with die thickness between halves of 8 in. Up to 4½ lb. of metal can be used per shot. Metal pot has a capacity of 400 lb. The machine occupies floor space of 6 ft. x 30 in.

Edi Trimming Machine Cuts Blueprints, Drawings, Tracings

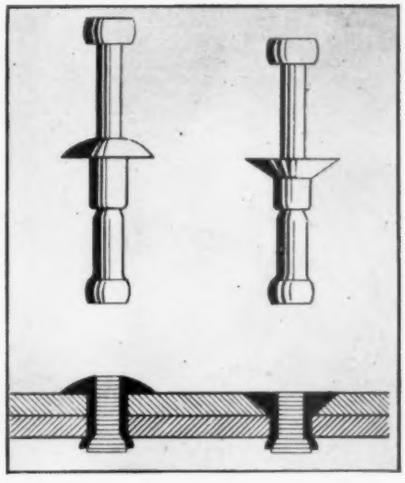
A device for trimming blueprints, drawings and tracing cloth has been developed by the Edi Trimming Machine, 611 W. 112th St., New York, N. Y. Material to be trimmed is firmly held in place, and cutting is performed by razor blades held on a sliding block. Table is calibrated to provide margins from ⅜ to 2 in. The trimmer is made in four sizes to cut material up to 25, 31, 43, or 55 in.



Blind Riveting Applications In Aircraft Aided by Cherry Rivets

Cherry rivet applications in aircraft assembly have been perfected by the Cherry Rivet Co., Los Angeles, Calif. These self-plugging rivets have a mandrel with an expanded section and head on the blind side. The expanded section is pulled into the hollow member and forms a tulip head on blind side.

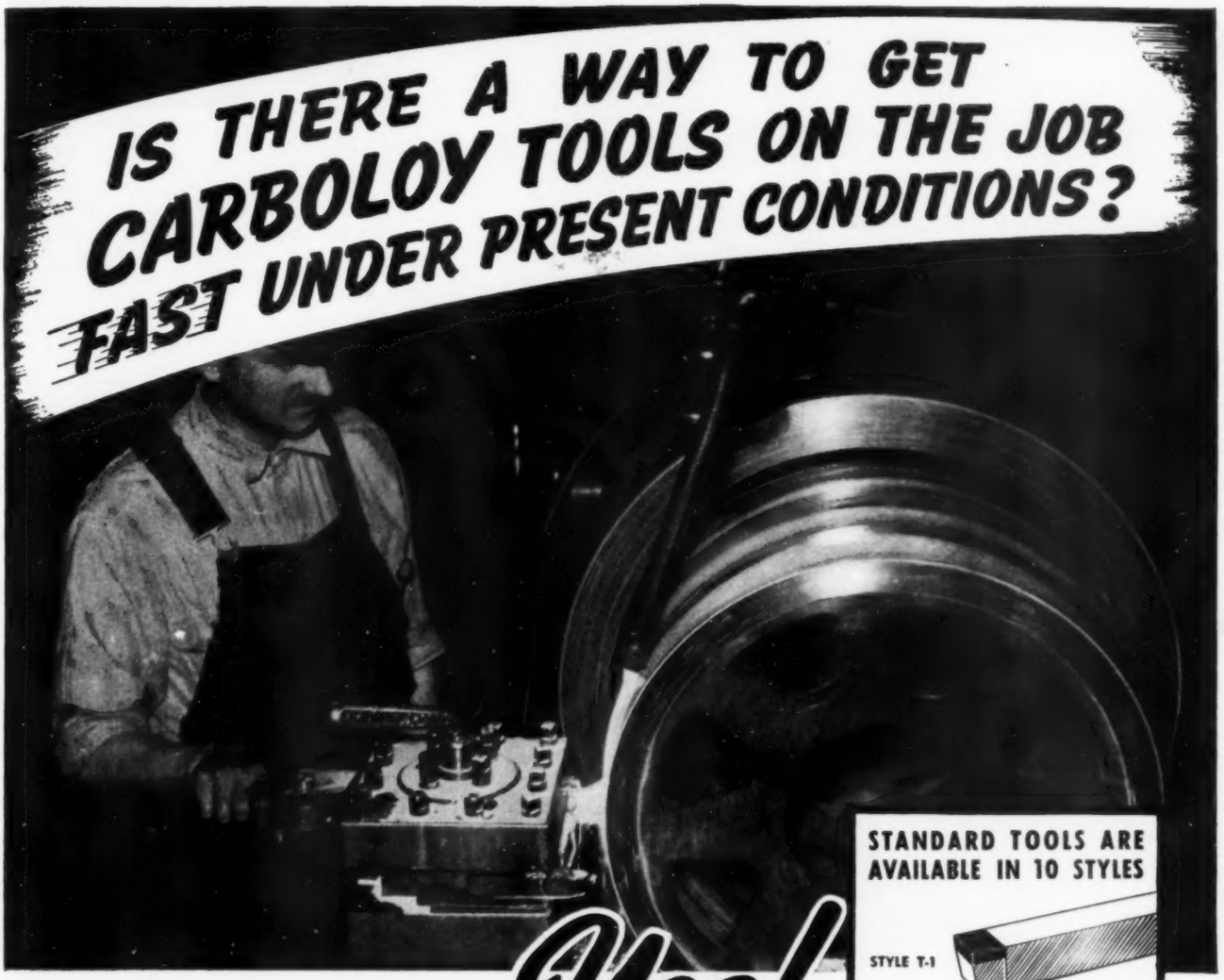
The operation is performed with



Self-plugging cherry rivets in brazier and countersunk types

Pneumatic and hydraulic pressure of this gun forms head on blind side of cherry rivet

IS THERE A WAY TO GET CARBOLOY TOOLS ON THE JOB FAST UNDER PRESENT CONDITIONS?



FALK CORP. SAYS *Yes!* "HERE'S HOW". . . . . .

When Falk Corporation, Milwaukee, needs specially shaped carbide tools *fast*—it's a matter of *minutes*—and the job is done!

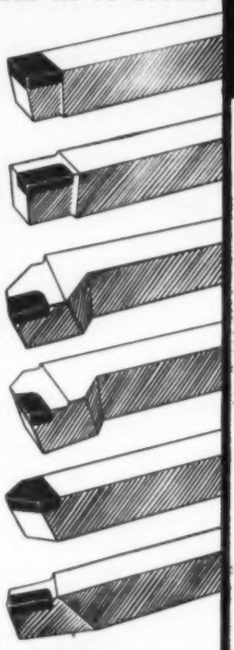
Take the above job, for example: Machining reduction gear blanks for the main drive of Uncle Sam's destroyers. 14 "specially" designed carbide tools required. Falk "makes" these specials—ready to go—in 135 minutes!

Here's how Falk saves weeks on not just this one job—but on 86% of their carbide tool requirements:

From the 10 styles of Carboloy Standard-Stock Tools—now being manufactured in "mass production quantities" for "universal" use on turning, facing, boring jobs—Falk has selected 9 styles to maintain in stock in their tool room. When specials are needed, Falk adapts the "standards" by quickly grinding the shape desired. Usually no more than a 10-minute job per tool—and as easy to do as the average regrinding of dull tools.

A 12-page booklet tells the story. Free, upon request.

STANDARD TOOLS ARE AVAILABLE IN 10 STYLES



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Chicago • Cleveland • Los Angeles • Newark • Philadelphia • Pittsburgh • Worcester, Mass.
Canadian Distributor: Canadian General Electric Co., Ltd., Toronto, Canada

CARBOLOY Reg. U.S. Pat. Off. **STANDARD TOOLS & TIPS**

"You ALWAYS Get Standards FASTER Than 'Specials'"

FREE 12-PAGE BOOKLET

either a hand-operated or an automatic gun. The outside end breaks off during application, and can be trimmed flush with ordinary nippers. Aircraft factory tests show this type of rivet can be applied and trimmed at the rate of 540 per hour by an unskilled operator.

Avey Machine Automatically Drills Many Small, Evenly Spaced Holes

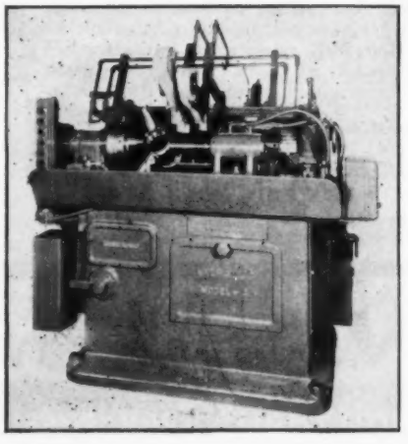
An automatic machine for drilling small, evenly spaced holes such as the turbine blade pin holes in turbine wheels has been introduced by The Avey Drilling Machine Co. Inc., 118 W. 2nd St., Cincinnati, Ohio. Operator loads part and pushes starting button. Machine drills one hole at a time and indexes on the back stroke of cam feed unit to complete as many holes as desired. Fixture moves in or out to take care of different diameter wheels and number of indexes as determined by master index ring under the fixture. Illustrated set-up drills 72 or 90, 3/16 in. holes.

T. & S. Drum Opener Cuts Safe, Smooth Edged Opening

A semi-automatic drum opener which cuts a smooth edged opening in metal drums up to 35 in. in height, has been developed by the Turner & Seymour Mfg. Co., Lawton Street, Torrington, Conn. Four steel uprights support the cutting unit, which is counterbalanced for easy adjustment to the height of the drum. After adjustment, the cutting unit is locked in position. Drum is perforated and cut by closing and turning the cutting unit lever. It saves time in opening drums and eliminates injuries which often resulted from the usual hammer and cold chisel method.

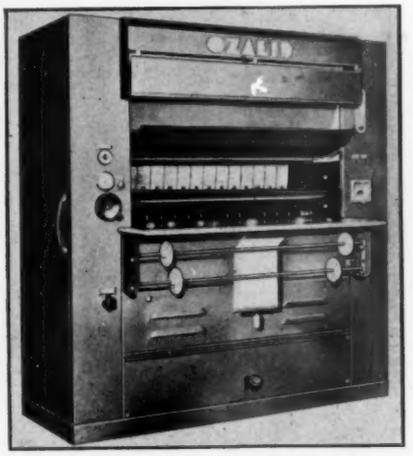
Schraner Adapts Model A Lapper For Finishing Propeller Hub Spiders

A. P. Schraner & Co., Payne Ave. and E. 33rd St., Cleveland, Ohio, has fitted its Model A machine with special adapter and loading device for the lapping of propeller hub spiders. Work pieces are loaded in three positions so as to lap two diameters in each position. Two lapping heads, arranged with automatic paper attachments produce uniform finishes at a production rate of approximately 25 complete pieces per hour. Finishes from two to three micro-inches are obtained.

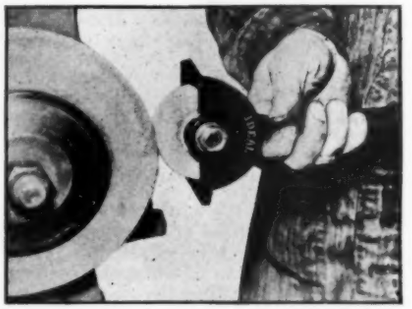


Ozalid Machine Produces Prints At Speed of 20 ft. Per Minute

Finished white prints can be produced at speeds up to 20 ft. per minute with the Model B white print machine put out by Ozalid Products Div., General Aniline & Film Corp., Johnson City, N. Y. Printer and developer are combined in one compact unit. Made in two easy steps—exposure and dry development. Original drawing is placed on a piece of light-sensitive ozalid material and fed to the machine. After exposure to a mercury-vapor lamp for printing, sensitive material is conveyed automatically over a developing tank and dry developed when it comes in contact with ammonia fumes. Prints are delivered at either front or rear of machine.



Ideal Grinding Wheel Dresser Has Excellent Cutting Effect



An abrasive wheel-type, grinding wheel dresser, said to give a cutting and truing effect almost equal to that of a diamond, has been announced by the Ideal Commutator Dresser Co., 1057 Park Ave., Sycamore, Ill. The cutting wheel is held in a protective metal housing which deflects the grindings away from the operator. Large handle makes it convenient to hold and use.

Besides general cleaning and truing, other uses include the truing of cut-up and uneven sides, dressing out deep grooves, and restoring out of balance wheels into true rotating ones. It can

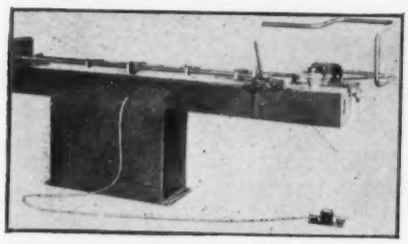
KEEPING "BUGS" OUT OF BRASS. In the making of brass and other copper-base alloys, Revere adds a vital ingredient—the *human touch*—that has a way of producing better metals. Behind each operation is a trio like Arthur Bower, Harry Schagrin and Alfred Roy, which combines the experience of a foreman, the knowledge of an engineer, and the skill of an able craftsman. Methods, supervision, operation, each is in very capable hands. It is such teams as these that keep "bugs" out of Revere metals . . . making them *right* for the needs of Defense today, and preparing well for the new needs of tomorrow's revived industry. Revere Copper and Brass Incorporated, 230 Park Avenue, New York.

also be used to shape wheels into different forms when form grinding is desired. Overall length is 13¾ in., and weight 3⅛ lb.

250 Bends Per Hour Produced By Pines Engineering's Tube Bender

An air-operated tube bender, capable of producing an average of 250 bends per hour on one-inch, single gage tube, has been developed by the Pines Engineering Co., 123 Main St., Batavia, Ill. Dies are actuated by the piston rod of an air cylinder which is controlled by a solenoid-operated four way air valve.

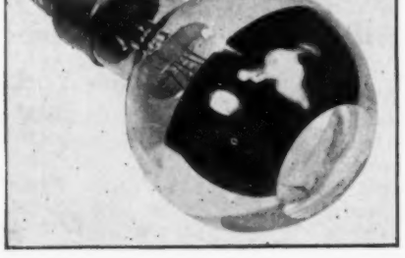
Valve is operated through either a



foot switch on the floor, or a conveniently located pushbutton switch on the machine. Designated as Series 200, the bender has a capacity of ⅜ to 1½ in. soft annealed copper or aluminum tubing, and ⅜ to 1 in., 16 gage soft steel tubing. It occupies floor space 10 x 1½ ft. and weighs approximately 1,500 lb.

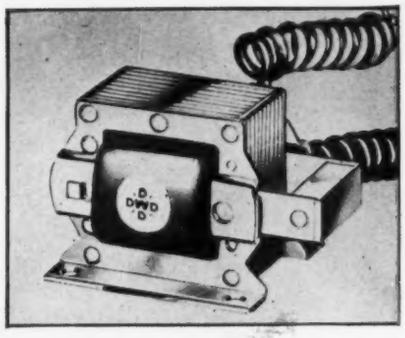
Wabash Infra-Red Lamp Projects Heat Beams Without Spill or Loss

An infra-red heating lamp which projects heat beams from the filament direct to heating area without spill or loss has been developed by the Wabash Appliance Corp., 335 Carroll St., Brooklyn, N. Y. The new bulb has a ring lining of pure silver sealed inside the bulb at a point just below the focal point of the filament. This leaves a clear "bullseye" spot through which heat beams are projected. All remaining heat rays, including what were formerly spilled, are now gathered into the control area of the reflector by the silver ring lining and projected down to the heating area. The lamp is available in 250 watt size and will have an average burning life in excess of 5,000 hours.



Compact Solenoid for Control Of Machinery Introduced by Davis

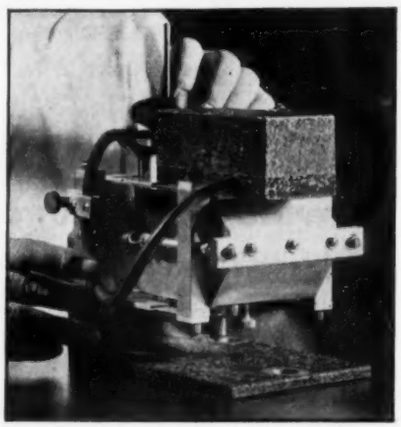
A compactly designed solenoid for control of production machinery is manufactured by Dean W. Davis & Co., Inc., 549 W. Fulton St., Chicago, Ill. It is



furnished with either push or pull type plungers. Made for any voltage, the solenoid has a minimum push or pull of 5.5 lb. at full line voltage, and 3.75 lb. at 85 percent of line voltage. It measures 2x2 in. with a plunger stroke of ¾ in. Field coil has been specially treated to be impervious to cutting oils.

Pick-up Aids Balancing Machines Which Rotate at Low Speeds

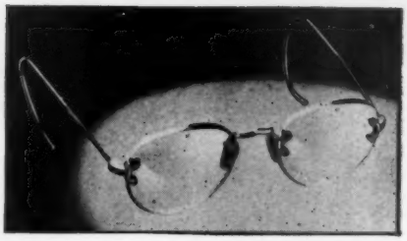
Machines rotating at speeds as low as 100 r.p.m. can be dynamically balanced on their own pedestals by means of the pick-up developed by Westinghouse Electric and Mfg. Co., East



Pittsburgh, Pa. Vibrations of double amplitude to 0.003 in. at 100 r.p.m. are indicated with the pick-up which is used with a standard portable balancing unit and conventional sine-wave generator.

Rimless Safety Glasses Made By Tulca for Supervisors, Checkers

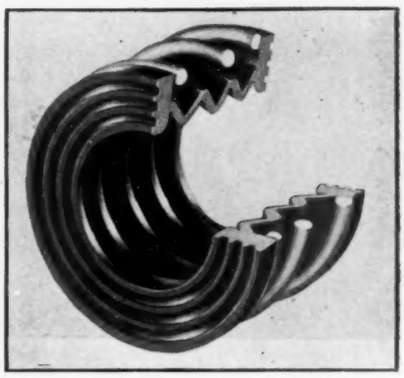
Rimless type safety spectacles for use by supervisors, checkers, inspectors and maintenance men have been added to the eye protection line manufactured by the Tulca Div., Univis Lens Co.,



Dayton, Ohio. They are as comfortable and pleasing in appearance as regular eye glasses. They come with or without side shields.

Crane Pump Seal Composed Of Spring, Synthetic Bellows

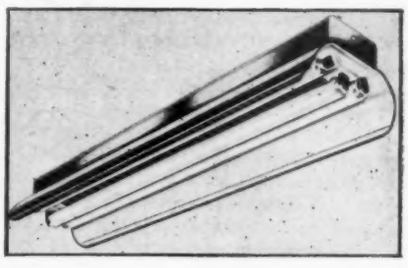
The Crane Packing Co., 1800 Cuyler Ave., Chicago, Ill. has produced a new water pump seal, which is composed of two parts—bellows and spring. Bellows, made of synthetic rubber compound, connects to flanged end. Spring is placed against the inside shoulders on



flanged end and holds the contact facings against the sealing washer on one end and the driving base on the other. The serrated contact facings are responsible for the positive seal at both the washer and driving base points. As both ends are identical, seals cannot be installed wrong.

Day-Brite Fixture Accommodates Three 40-Watt Fluorescent Lamps

Industrial fluorescent fixtures to accommodate three 48-in., 40-watt fluorescent lamps have been introduced by Day-Brite Lighting, Inc., 5411 Bulwer Ave., St. Louis, Mo. Known as the "Three-Forty", the fixture is made for



SUNOCO *helps*

SAVE 23 MINUTES

on a 50-minute job!

PERFORMANCE DATA

OPERATION – Turning, boring, facing and necking Chuck Sleeve.

MACHINE – Warner & Swasey 3-A Universal Heavy Duty Turret Lathe, with new Adjustable Single Turning Head.

MATERIAL – S.A.E. 3150 steel forging.

CUTTING SPEED – 200 S.F.P.M.

CUTTING LUBRICANT – 1 part Sunoco to 20 parts water.

Courtesy of
WARNER & SWASEY CO.

NEW HIGH P-Q* SET IN MACHINING S.A.E. 3150 STEEL

Once again that perfect combination — skilled operator, good machine and SUNOCO Emulsifying Cutting Oil — teams up to make possible a new, higher P-Q* (Production Quota) on an important cutting operation.

Formerly it took 50 minutes to machine this Chuck Sleeve. Now, using a new type Adjustable Single Turning Head, carbide cutters and SUNOCO Emulsifying Cutting Oil, it takes 27 minutes. The manufacturer adds:

> "We readily appreciate the fact that the use of proper cutting oils is a big factor in helping us increase our turret lathe production."

Today the leaders look to SUNOCO for increased machine tool output . . . for the means to a higher P-Q*. They know SUNOCO's high lubricating and heat-absorbing qualities permit deeper cuts at faster speeds, longer tool life, nth degree accuracy and fewer rejects.

Test SUNOCO in your own plant . . . under your own operating conditions. Call in one of SUN's "Doctors of Industry"— a metal working expert — for recommendations. Write or wire

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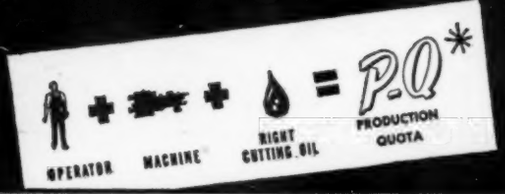

SUNOCO
EMULSIFYING
CUTTING OIL

SUN OILS

PETROLEUM PRODUCTS FOR ALL INDUSTRIES

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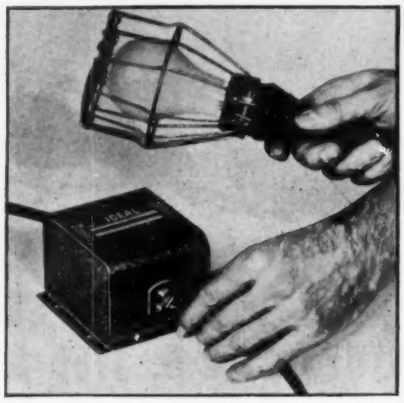
either chain or pipe suspension. The top is hinged and swings open to make all parts accessible. Reflector is one piece porcelain enamel. Unit is 7¾ in. high, 13½ in. wide, and 52 in. long.

Ideal Step Down Transformers Used in Dangerous Spots

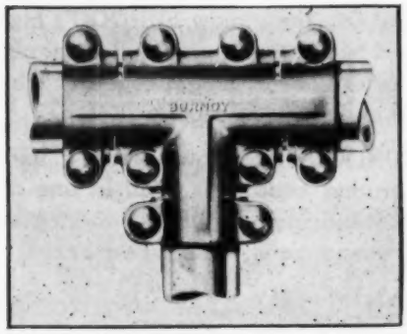
A step down transformer, that is easily plugged in between the power supply and the light cord extension to reduce extension voltage to a harmless 6 volts, was developed recently by the Ideal



Commutator Dresser Co., 1057 Park Ave., Sycamore, Ill. Recommended for use in damp, all metal or otherwise hazardous locations, the device eliminates danger from shock caused by bad sockets, or defective extension cords. Transformer has a 10 ft., three-conductor type safety primary cord. With a 25 ft. extension, the capacity is 50 watt. Unit is available for 110 volts, 50-60 or 25 cycle a.c.

Slots Provide High Pressure Contacts on Burndy Connectors

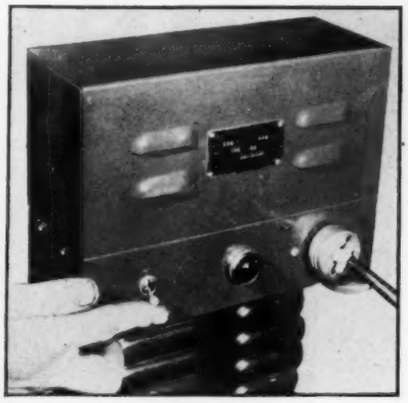
A multigraph type T-Connector, Type NST, for tubing, run and tap is being marketed by Burndy Engineering Co., Inc., 459 E. 133rd St., New York, N. Y.



Oval-shank bolts can be installed with one wrench. Slots between bolts provide independent high pressure areas of contact. The connector is available in sizes from ⅜ to 6 in. Aluminum and aluminum-to-copper combinations are available.

Savage Doall Rectifier Transforms A.C. to D.C. for Operating Chucks

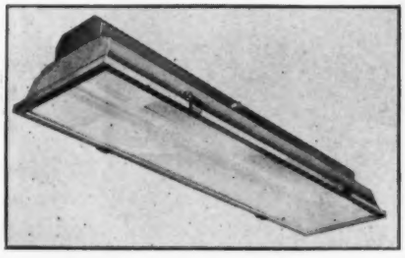
A Doall rectifier for transforming alternating current into direct current for the operation of electro-magnetic



chucks has been introduced by the Savage Tool Co., Savage, Minn. Packed in an 11x4¾x7¾ in. welded steel case, the rectifier is operated from a toggle switch and contains a built-in pilot light to show when it is in operation. It will operate any electro-magnetic chuck from 6x18 in. to 8x24 in. in size. The unit contains no moving parts.

Westinghouse Luminaire Uses Two or Three Fluorescent Lamps

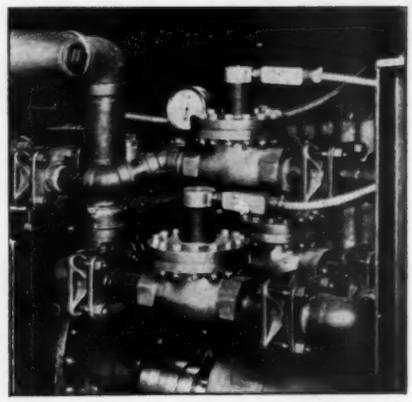
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., have announced a Luminaire using two or three 40-watt fluorescent lamps. These units, known as Type FPS-40 provide lighting inten-



sities from 30 to 100 foot-candles. Twin ballasts with built-in compensators provide power factor of 90 percent or over.

High Pressure Valves Furnished For Gas, Air, Liquid Operations

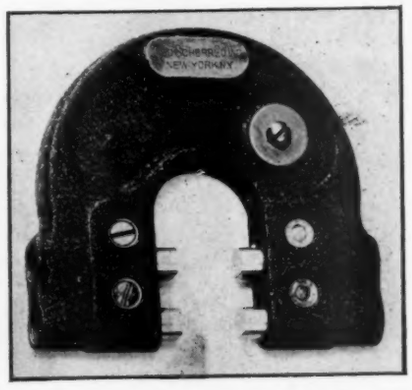
High pressure valves for operating pressures up to 3,000 lb. have been added to the Atkomatic line produced by the E. C. Atkins & Co., 402 S. Illinois St., Indianapolis, Ind. They are available in ⅛, ¾ and 1½ in. sizes. Valves are bronze with renewable seats and disks. Bubble-tight pilot assembly can be furnished for air and gas operations as well as



liquid. Valve shown operates a 250-ton press at 1,000 lb. pressure. When press hits full load, pressure goes to original accumulator pressure with no time lag. Previous valves took pressures up to 300 lb.

Geo. Scherr Co. Makes Two Adjustable Limit Snap Gages

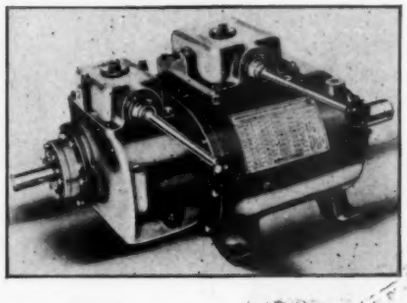
Adjustable limit snap gages are manufactured by the George Scherr Co., 128 Lafayette St., New York, N. Y. They come in two standard types: Model A



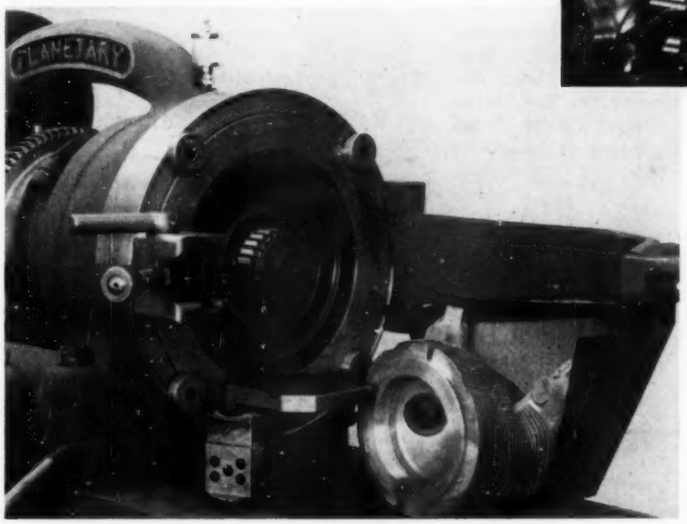
with four gaging buttons, and Model C with solid block and two gaging anvils. Sizes are available to gage parts up to 6 in. across.

30 Hp. Western Transmissions Motorize Cone Driven Machines

Western Mfg. Co., 3428 Scotten Ave., Detroit, Mich., has developed a transmission with 30 hp. capacity for motor-



Now...they MILL THREADS *for Accuracy*



ABOVE—*Hubs for Curtiss Electric Propellers coming down the line. Operator is loading a hub into a Hall Planetary for milling the threads with Detroit thread milling cutters.*

LEFT—*Cylinder heads for radial aircraft engine being milled with a Detroit Tap cutter which also forms the I.D. of the head above the threads at the same time.*

IT WAS ONCE thought that for maximum precision, threads had to be ground. Today you can produce super accurate threads by milling. It is being done every day in the aircraft industry.

For instance, you will find that the close tolerance modified buttress threads in propeller blades and hubs, the threads by which cylinder heads screw into barrels, etc., are now produced to finished specifications, in one operation, with "*Detroit*" precision ground thread milling cutters.

The reason is simple. "*Detroit*" thread milling cutters are precision ground to tolerances closer than the most accurate of production thread requirements.

That's how all *Detroit Tap* products are made, whether they be milling cutters or hobs, standard or special taps, plug or ring type thread gages. Every one is precision ground of special wear-resisting alloys, precision-ground on machines developed for that purpose, and that purpose only.

Detroit Tap products are not built to a price. They are built to cut thread-production cost and thread-production time. Their low cost is a matter largely of quality-in-quantity . . . quantity demands which have quintupled *Detroit Tap's* plant capacity in the past year alone.

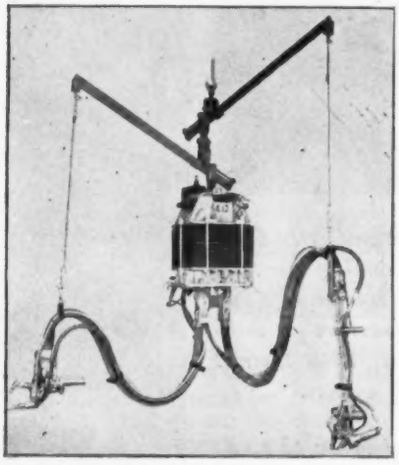
May we send you a catalog? You may be surprised how little 'Detroit' precision costs.

DETROIT TAP & TOOL Company 8432 BUTLER DETROIT

izing cone driven machine tools. Suitable for replacement of gear boxes on large boring mills and radial drills, it may also be used to motorize large slotters, engine and turret lathes. It has eight changes of speed in geometric progression of 1.29. Maximum reduction 6 to 1.

Springless Hangers Support Welding Transformers, Guns

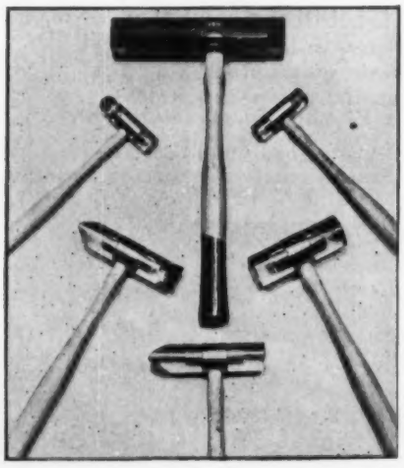
Compound springless, adjustable hangers suitable for counterbalancing two separate units such as welding guns, have been introduced by Progressive Welder Co., 3001 E. Outer Drive, Detroit, Mich. Hangers are individually



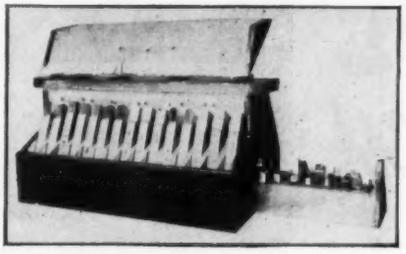
adjustable for weights to be counterbalanced. They come in two sizes—one to support welding transformers and guns up to 75 kva., the other to support units rated up to 150 kva. Riveting equipment and other heavy hand tools can also be hung from this equipment.

Plastic Hammers for Tool Shops Introduced by Rapid Mfg. Co.

A line of plastic hammers, especially developed for tool and machine shop use, was recently introduced by Rapid



Mfg. Co., Glendale, Calif. With these hammers any metal or plated surface can be struck a full blow without being marred. All but one hammer have replaceable tips. The handles are seasoned hickory, securely wedged and keyed in solid steel heads, so they cannot twist or turn. Available in all standard peens, they range in weight from 3 to 18 oz.



Carboloy Carrier Segregates Tools by Grade, Style and Use

A carbide tool carrier for segregating tools according to grade, style and type of work on which used, has been designed by the Carboloy Co. Inc., 11149 E. Eight Mile Rd., Detroit, Mich. Such a kit may be kept intact or loaded to order in the tool crib.

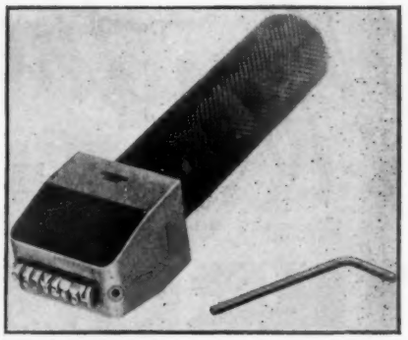
Impact Wrench Is Short, Has Small Nose for Close Clearances

Because of its short overall length and small nose diameter, the size 508 air-operated impact wrench, developed by Ingersoll-Rand Co., Phillipsburg, N. J.,

can be used in close places. Impact is localized without transmitting shocks to other parts of the tool. It is easily operated with one hand. Average working speed at 90 lb. air pressure is 850 r.p.m. It weighs 8½ lb. and is 10 13/16 in. long without chuck. It is recommended for nuts up to ⅝ in. bolt size.

New Method Wedge Lock Keeps Stamps From Slipping in Holder

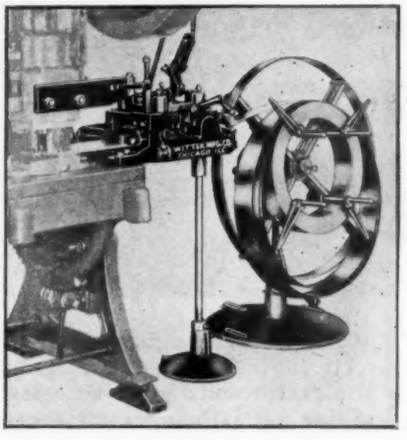
A special wedge lock prevents the individual hand stamp from loosening in the interchangeable stamp holder designed by New Method Steel Stamps, Inc., 145 Jos. Campau, Detroit, Mich.



The wedge holds the stamp both sidewise and endwise against movement. A single set screw at the end retains all the stamps in position. Body of the holder is large and shank is knurled. The holders are made to accommodate any number of characters and all sizes of stamps. They are also available with shanks which can be fitted on presses.

Stock Fed Into Punch Press By Wittek's Automatic Roll Feed

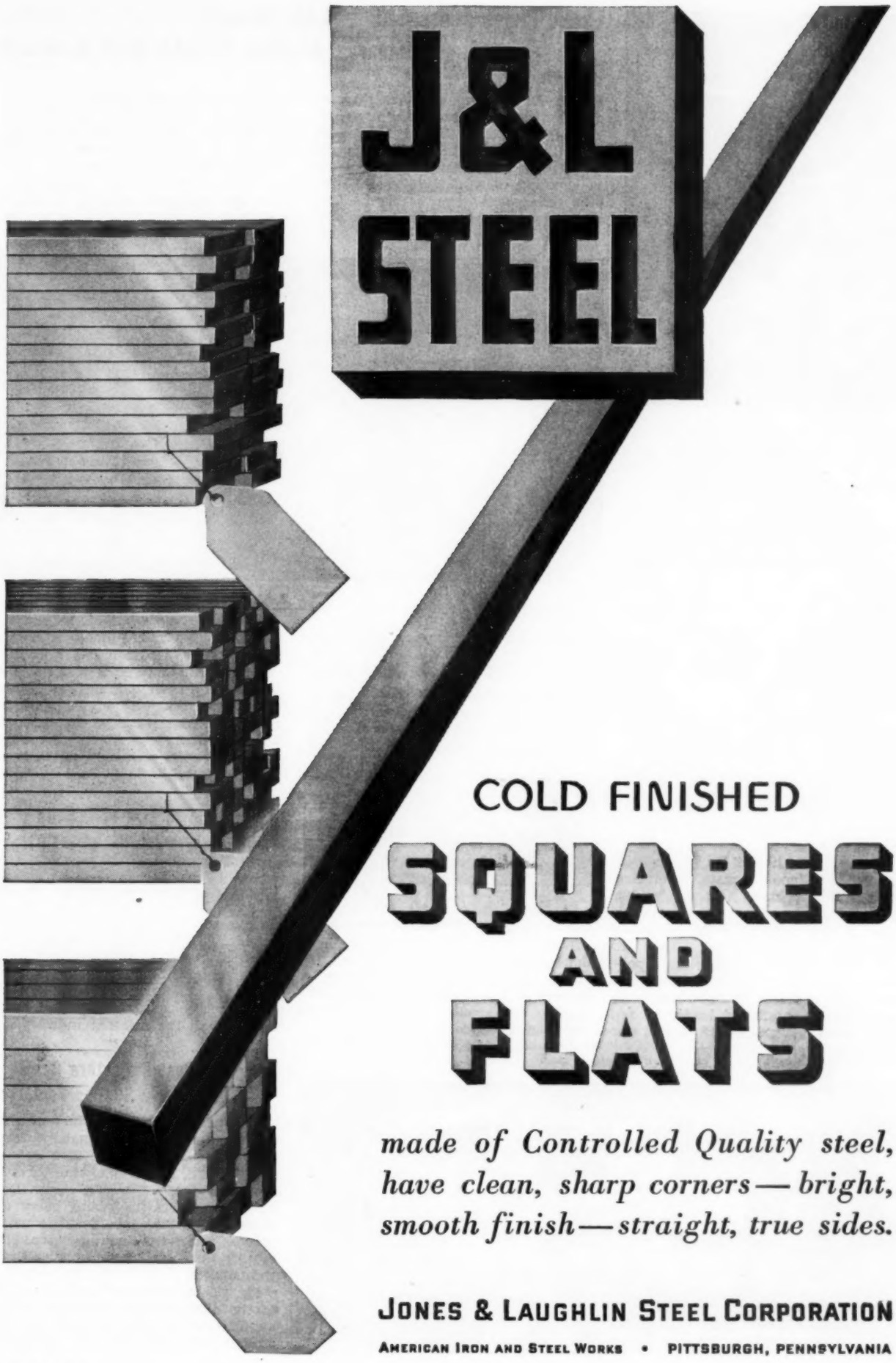
Automatic roll feed and reel stand for rapid smooth and accurate feeding of



stock into punch press, is manufactured by Wittek Mfg. Co., 4305 W. 24th Place, Chicago, Ill. The rolls turn constantly while the foreward movement of the stock is arrested momentarily to allow for stamping operation and ejection of the stamped part. Power is transmitted by a chain drive from a sprocket mounted on the crank shaft of the press and connected to the drive shaft of the feed.

Gisholt Turret Lathe Tool Holds Small Boring Bars

A rapid slide tool for turret lathes has been announced by the Gisholt Machine Co., 1201 E. Washington Ave., Madison, Wis. It is designed to hold small boring bars and forged cutters. Movement of the lever transmits a rapid, smooth motion to the slide per-



COLD FINISHED

SQUARES AND FLATS

made of Controlled Quality steel, have clean, sharp corners — bright, smooth finish — straight, true sides.

JONES & LAUGHLIN STEEL CORPORATION

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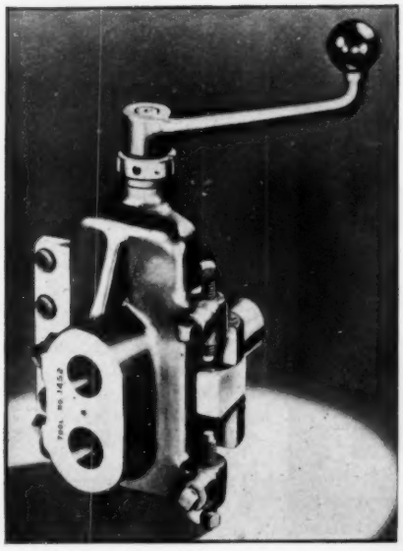
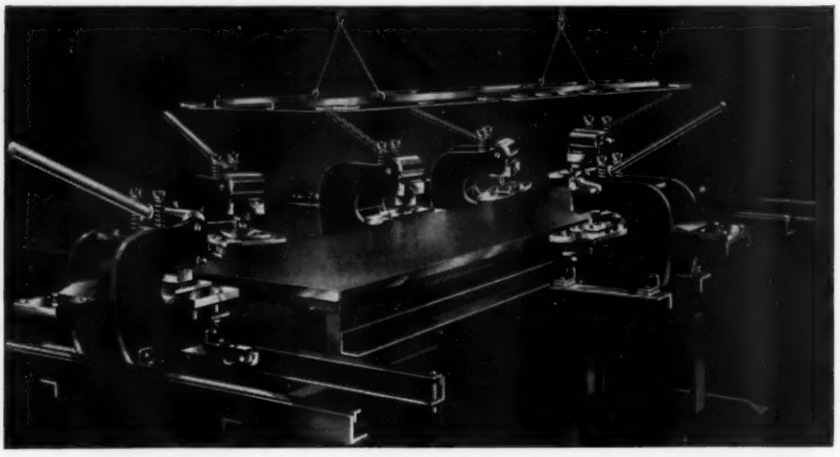


Leslie Punch Presses Have 6-In. Throats; Universal Aligning Provides High Accuracy

Model A positive alignment hand-operated punch presses have been developed by Leslie Welding Co., 2943 Carroll Ave., Chicago, Ill. Press has a 6 in. throat and takes dies up to 4x4½ in. as standard. In special cases, however, larger dies can be used. The capacity of the press is a 2 in. diameter hole in 10 gage mild steel.

Universal aligning provides accuracy to 0.0001 in. The cam which is 5 in. long by 3 in. in diameter prevents lateral rocking of the punch plate. This non-rocking feature also makes possible the punching of half holes or notching.



mitting back-spacing and recessing operations. Adjustable stops are provided for quick setting and permit duplicate work.

.30, .50 Caliber Cartridge Cases Finished in Ransohoff Pickler

A batch finish pickler used to put the final finish on .30 and .50 cal. cartridge cases has been designed by N. Ransohoff, Inc., Elmwood Place, Cincinnati, Ohio. Completely automatic, this machine consists of three batch rolling or tumbling barrels in series. Construction permits the work to remain in the drums while rotating in one direction and to be automatically discharged when rotation is reversed. In the first tank made of stainless steel work receives an acid roll. In the second it gets a soap roll, while in the third unit work is drained and automatically dried.

Drying air is heated by steam coils or Venturi type burners, operating in a stainless steel heat exchanger. Entire action is controlled by a master time switch which opens a gated hopper to feed batch in first unit. It also controls drum rotation and operation of the pump. Automatic operation provides better finish with a large saving in labor. Power loader to receive work at ground level can be attached.

Roughness Ratings Read Directly With Physicists Research Meter

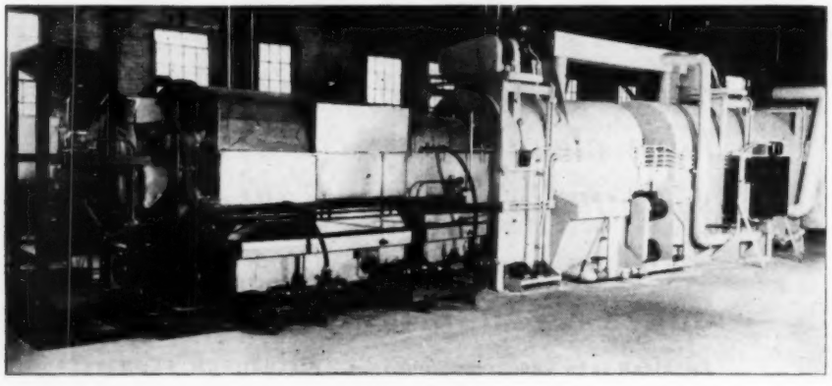
Roughness ratings can be read directly in true inch units with the Type P profilometer manufactured by Physicists Research Co., 343 So. Main St.,

Ann Arbor, Mich. The unit is entirely self-contained and requires no electrical connections. It contains a small non-spillage storage A battery and dry B battery. A small charger for the A battery is furnished. The meter will operate for about 10 hours continuously on a single A charge.

Full scale ranges of 3, 10, 30, 100, 300 and 1,000 micro-inches are supplied. Range is adjusted by a selector switch. With a Type S tracer it can be used on external surfaces larger than ⅛ in. diameter, on flat surfaces and on internal surfaces greater than 2⅝ in. in diameter. A special tracer is used on inside diameters down to ½ in. Total weight is 33 lb.

Dixon Adds to Line of Pencils Used to Mark Layouts on Metal

Purple and green have been added to the line of Phano pencils, manufactured by the Joseph Dixon Crucible Co., Jersey City, N. J. These grease pencils, used largely for marking highly polished metal, leave a clear, durable mark, without danger of scratching or scoring. They are used to make layouts directly on aluminum and stainless steel in the aviation industry.



Pangborn Dust Collectors Come In 4 Sizes; Suction Preferred

Unit type dust collectors in four sizes are being marketed by Pangborn Corp., Hagerstown, Md. All are identical except for size, taking one, two, three or four banks of 18 screen each. Dust laden air enters the casing below the screen. It strikes a baffle plate which reduces velocity to such an extent that coarser dust particles drop directly to the hoppers.

Finer dust is returned on the dust side of the cloth screens with the cleaned air filtering through the cloth and discharging through the open top of the

collector. Machine may be operated under either suction or pressure. Suction operation is preferred, as wear is decreased because exhauster handles only cleaned air.

Screen frames are constructed of cypress. Metal caps cover the bottom to prevent scoring of bags and frames. Special woven filter cloth is sewn in bag form for slipping over the screen frame. Each screen bank is fitted with a manually operated rapper. From top of cabinet to bottom of hopper is 6 ft. 9½ in. Clearance between hopper and floor can be 1½ ft., 2½ ft., or 3½ ft. Where head room is limited, hoppers may be replaced by a flat bottom dust box with clean-out door. Collectors are shipped completely assembled.

NEW MATERIALS

Quaker Compound Removes Oil, Grease and Dirt From Metals

Quasol No. 80 has been developed by Quaker Chemical Products Corp., Conshohocken, Pa., for removing grease, oil and dirt from all types of metals. Used in industrial washing machines, 1 gallon is mixed with 25 to 75 gal. of water depending on the cleaning job.

Crowley Produces High Frequency Cores in Big Sizes, Special Shapes

Large sized and special shaped iron cores are being turned out by Henry L. Crowley and Co., 1 Central Ave., West Orange, N. J. These high frequency cores are produced for fine instruments, induction furnaces and X-ray apparatus among other equipment. Shapes include L's, disks, spools, rings and tubes.

Damaged Tin Surfaces Repaired With Metallic Coating Powder

For making repairs to damaged tin coatings, the American Solder & Flux Co., Trenton Ave., and Norris St., Philadelphia, Pa., has developed a Brand K Amco metallic coating powder. The coating is rust resistant and will give thorough protection to underlying iron or steel. Since the melting

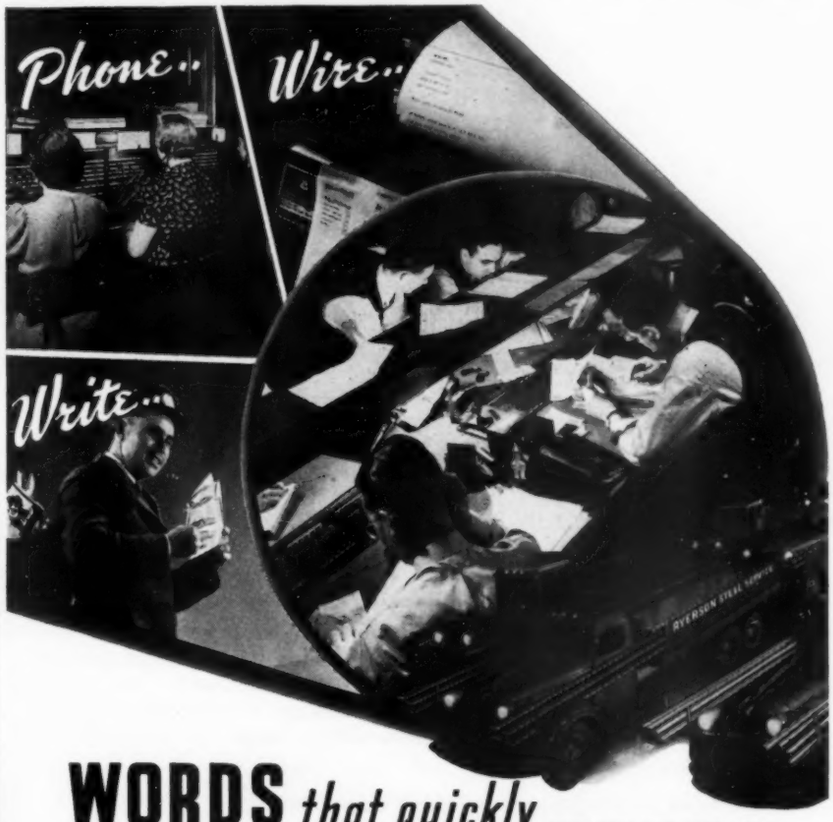
(Advertisement)

Manufacturers Look to Steel Warehouses for Quick Defense Requirements

Many leading manufacturers are relying on nearby steel-service plants for prompt stock shipment of steel to meet the current surge of business prompted by Washington's defense program.

Probably the leading exponent of "Immediate Steel" is Ryerson with a net work of ten strategically-located plants, each of which has large and complete stocks of steel and allied products. In addition, each plant is equipped with complete forming and cutting facilities so steel can be prepared to customer's exact requirements. No shop should be without the Ryerson Stock List (see advertisement below).

Thousands of manufacturers report saving considerable time, trouble and money by taking advantage of Ryerson's complete flame cutting service. Modern equipment manned by specially trained operators can quickly burn any shape—no matter how intricate—from carbon or alloy steel plates and billets up to 15" thick.



WORDS *that quickly turn to* **STEEL**

SUBMIT your steel requirements to this experienced, highly-specialized source. Telephone, wire, or write—however you communicate, you'll get action and effective co-operation.

If you phone, experienced operators connect you, *without waiting*, with a Ryerson steel man, a man who talks *your language*. Wires are received by teletype, direct from central telegraph offices. Mail is picked up hourly at the post office, a *faster service* than special delivery.

In almost a matter of minutes, your words have become steel — steel that is on its way back to serve you.

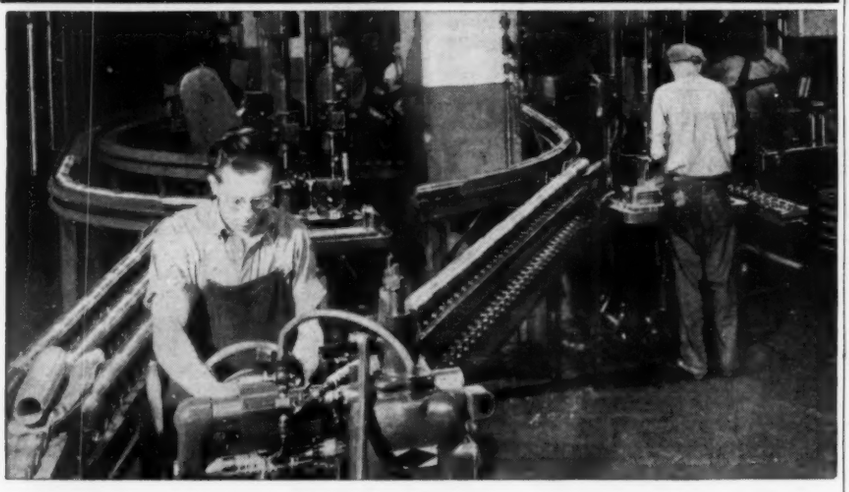
Rapid handling of incoming orders is typical of Ryerson service in *every department*. It matches large and varied Ryerson stocks and Ryerson Certified Quality — an unequalled service to American Industry. Because many sizes are low or even missing, "Open orders" are advisable during the emergency. Stock list sent promptly on request.

Joseph T. Ryerson & Son, Inc., Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Boston, Philadelphia, Jersey City.

RYERSON CERTIFIED STEELS

RYERSON

GET SPEED! .. AND SAVE MONEY, TOO



Installed at strategic points in your production system—Standard Conveyors often prove to be practically the only equipment needed to accelerate the pace of production. Saving valuable time—using plant space more effectively—Standard Conveyor engineers have worked out problems like these for many manufacturers. Here is a representative example in a large armament plant where Standard Conveyors are used for fast, safe "line" production of 3 inch A. A. shell:

We selected your type of roller conveyor for all of our conveying operations because we felt that the contour of your steel roller is very favorable to the transportation of shells which have a finish turned copper band on them. The concave roller gives the band a two-point contact, and consequently reduces the liability of damage by 50% over what it would be if the rollers were straight or just slightly concave.

Get Conveyor Engineering That Shows Results

Because of operating benefits like those cited above, Standard Conveyors inevitably result in stepped-up production, plus a substantial bonus of cost savings in material handling. To be certain of conveyor engineering that will show results, call in a Standard Conveyor engineer—check with him to see how Standard Conveyors can earn and save in your plant.

Send for 76-page Standard Booklet

Interesting and informative, this booklet, AM-12, "Conveyors by Standard," will prove a valuable reference book on conveyors and conveying methods to every production executive and others concerned with fast, low-cost material handling.

STANDARD CONVEYOR COMPANY

General Offices: North St. Paul, Minn.

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"THE STANDARD OF VALUE"

Standard CONVEYORS

FIRST FOR FASTER PRODUCTION

point is lower than tin, the original coating is not melted or disturbed by the application of Brand K. The coating of repaired areas joins with the undamaged surrounding area to form a continuous protective surface.

Alrose Process for Blackening Iron, Steel Saves Costs, Time

The Jetal process for blackening iron and steel has been announced by the Alrose Chemical Co., Providence, R. I. The finish is rust resistant. Approximately 30 percent savings are made in cost and treatment time.

Magnolia Babbitt Metal Used Where Bearing Loads Are Heavy

A babbitt metal with a tensile strength of 17,500 lb. per sq. in. and a yield point of 6,500 lb. per sq. in. has been developed by Magnolia Metal Co., 120 Bayway, Elizabeth, N. J. Its strength makes the metal adapted to heavy bearing loads, such as are encountered in railroad service, heavy rolling mill machinery and large generators and motors. The metal has a brinell hardness of 27, and its pouring temperature ranges from 95 to 1,000 F.

TRADE PUBLICATIONS

ALUMINUM BRONZE WELDING The welding technique and application of coated aluminum bronze welding rod is detailed in a 16-page catalog recently issued by Ampco Metal, Inc., 1745 So. 38th St., Milwaukee, Wis. Several drawings of welding methods, photographs of typical beads and X-ray views illustrate the book.

BORE CHECKING The Sheffield Corp., Dayton, Ohio, describes the Precisionaire method of checking long bores and small or relatively inaccessible holes in a six-page bulletin, No. 41–19.

CAST STEEL VALVES The Edward Valve & Mfg. Co., Inc., East Chicago, Ind., has released a 56-page catalog No. 12 of cast steel valves.

CHARTS C. J. Tagliabue Mfg. Co., Park & Nostrand Aves, Brooklyn, N. Y., has issued Catalog No. 1230 of chart for recording thermometers, pressure gages and controllers.

DEFENSE TREATING Uses of heat-treating in producing national defense munitions are described in "The Great American Emergency," a 21-page booklet published by Surface Combustion Corp., Toledo, Ohio. Items covered include cartridge cases, projectiles, bombs, gun barrels, armor plates and airplanes.

DIE CRADLE Descriptive literature on a die cradle has been prepared by Acro Tool & Die Works, 2832 Montrose Avenue, Chicago, Ill.

DRILLS Use of hardsteel drills is outlined in a booklet put out by Black Drill Co., 5005 Euclid Ave., Cleveland, Ohio.

DRILL PRESS A 17-inch power feed drill press is described in a folder published by the Delta Mfg. Co., 600-634 E. Vienna Ave., Milwaukee, Wis.

DUST CONTROL Dust collectors are described in a four-page folder issued by Aget-Detroit Mfg. Co., 958 Book Building, Detroit, Mich.

ELECTRICAL EQUIPMENT Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has revised its quick selector catalog of industrial electric equipment.

FEEDING EMPLOYEES "Why Feed Your Employee," the story of one company's experience in providing eating facilities for its workers, has been prepared by Mono Service Co., Newark, N. J.

FINISHING Suggestions for improving and lowering costs of finishing metal surfaces are included in a folder published by Sundstrand Machine Tool Co., Rockford, Ill.

FURNACE CONTROL Control systems for forging furnaces are described in Bulletin No. 23-57 recently published by the Brown Instrument Co., Wayne & Roberts Aves., Philadelphia, Pa.

HEAT-TREATING EQUIPMENT Alloys, from which boxes, containers, retorts, and other equipment used in heat-treating operations, can be manufactured, are described in a booklet published by the American Manganese Steel Div., American Brake Shoe & Foundry Co., 389 E. 14th St., Chicago Heights, Ill.

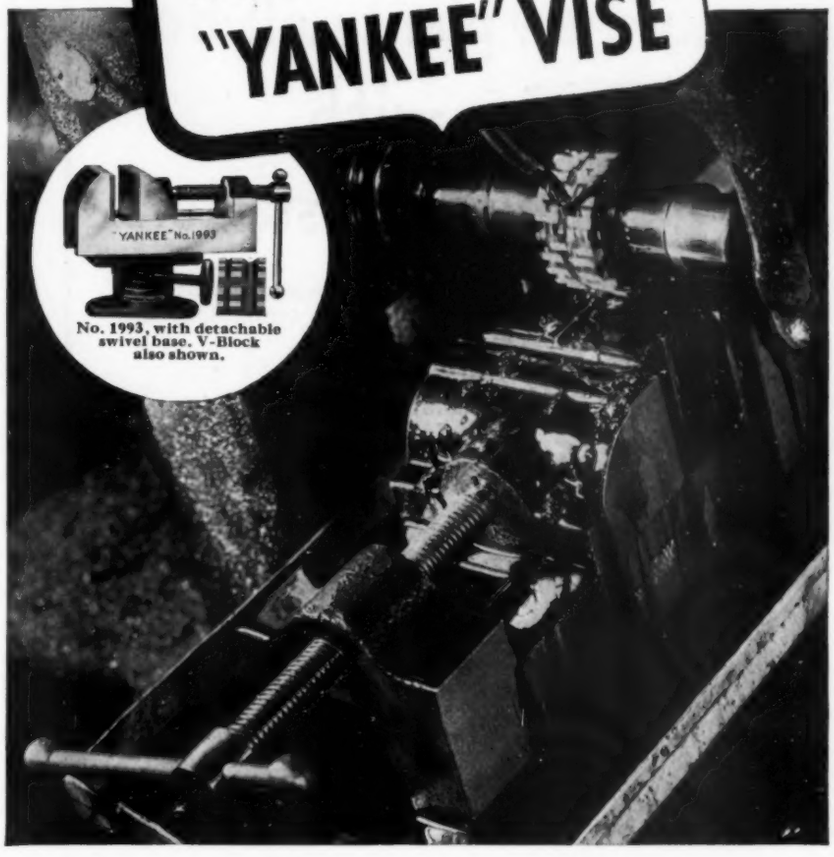
HOLDERS Holding fixtures for tapping machines are described in a 12-page bulletin circulated by R. G. Haskins Co., 615 So. California Ave., Chicago, Ill. Several illustrations of fixtures in use are included.

HOSE HINTS The Mechanical Goods Div., United States Rubber Co., Rockefeller Center, New York, N. Y., has issued a new manual including useful hose information.

INDUSTRIAL CONTROLS A 56-page catalog, No. 8301, of industrial controllers of temperature, pressure, humidity and combustion has been released by the Brown Instrument Co., Wayne & Roberts Aves., Philadelphia, Pa.

INDUSTRIAL PUMPS Case histories of applications of industrial pumps are

FEWER OPERATIONS mean FASTER MILLING with the "YANKEE" VISE



No. 1993, with detachable swivel base. V-Block also shown.

Cut out waste motions—they are costly and time-consuming! The "Yankee" Vise is designed to speed production. Once work is squared on face plate or machine bed it *stays* squared because the sides, front end and base of the "Yankee" Vise are accurately machined. If work must be moved from bench to drill press or milling machine, it can be done quickly and easily without realignment. The same vise can be used for round stock, simply by inserting a hardened steel V-block that's furnished as standard equipment. All these "Yankee" features save time and production costs.

Order from your supply house . . . or write North Bros. Mfg. Co., Dept. AM, Phila., Pa., U.S.A.

"Yankee" Vises are made in four jaw widths and two styles. No. 991—1½"; No. 992—2"; No. 993—2¼"; No. 994—4". These same sizes with the detachable swivel base feature are Nos. 1991, 1992, 1993, 1994.

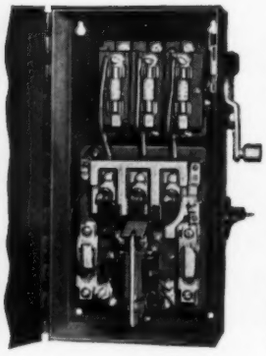
"YANKEE" TOOLS
make good mechanics better
NORTH BROS. MFG. CO., Phila., U.S.A.

Joe...the employees in your new plant will be safer with G-E combination starters

"We've found that we can place these starters next to a machine without fear of operator's tampering with box while machine is in operation."*

**Statement by Raymond Dingler, chief electrician, Monolith Portland Midwest Co., Laramie, Wyoming*

Safer than Separate Devices in 3 Ways—



SAFER because the fused manual circuit switch is ***selected*** for use with your motor—no danger from interrupting heavy overcurrents in an emergency.

SAFER because the cover ***can't*** be opened as long as the circuit switch is closed and power is applied to the starter and the machine.

SAFER because ***as long as the cover remains open*** the line switch cannot be accidentally closed, applying power to the parts being inspected.

GENERAL ELECTRIC

676-44-8490

illustrated in the 24-page bulletin No. 29–A107 recently distributed by Pomona Pump Co., Pomona, Calif.

MARKING METHODS Marking machines and methods are described in the booklet "Skill in Machines" distributed by The Acromark Corp., 251-257 N. Broad St., Elizabeth, N. J.

METAL CUTTING Spartan Saw Works, Inc., Springfield, Mass., is issuing its latest metal-cutting manual and reference catalog.

MICROMETERS Tubular micrometers and standards with capacities ranging from 0 to 168 in. are described in a folder by Davis & Thompson Co., 6619 W. Mitchell St., Milwaukee, Wis.

MIDGET PUMPS Eastern Engineering Co., 45 Fox St., New Haven, Conn., describes midget pumps in a booklet, No. 15341.

MOTOR OPERATION General Electric Co., Schenectady, N. Y., has issued Publication GED-972A which discusses an electronic control system for operating d.c. motors from a.c. supply lines.

MOTOR STARTER The General Electric Co., Schenectady, N. Y., has released Publication GEA-3660 which explains in detail the design, construction and application of a 2,300 volt contactor motor starter.

PARTS FROM POWDER A large number of parts produced from powdered metals are illustrated in a folder prepared by Bound Brook Oilless Bearing Co., Bound Brook, N. J.

PLATING ANALYSIS The sixth edition of a 48-page booklet giving in detail methods of analyzing plating solutions has been published by the Hanson-Van Winkle-Munning Co., Matawan, N. J. A new section covers electro-chemical data for the important metals.

PLATING TEMPERATURES Instruments for controlling temperatures in plating and other metal finishing operations are described in Bulletin B-296 published by the Foxboro Co., Foxboro, Mass.

SHEAR ATTACHMENTS Auxiliary attachments for rotary shears are described in an eight-page bulletin put out by Quickwork-Whiting Div., Whiting Corp., Harvey, Ill.

SHELL CENTERING Shell centering machines are described in a bulletin prepared by Stokerunit Corp., 4548 W. Mitchell St., Milwaukee, Wis.

SOCKET SCREWS A 10-page folder No. 845, describing Hex socket screws has been prepared by the Bristol Co., Waterbury, Conn.

SNAP GAGES Adjustable limit snap gages are described in a folder put out

by George Scherr Co., Inc., 128 Lafayette St., New York, N. Y.

SPRAY NOZZLES Various head and nozzle assemblies for all types of materials sprayed by syphon and pressure feed guns are illustrated in a chart compiled by the Alexander Millburn Co., 1493 W. Baltimore St., Baltimore, Md.

STEEL SHAPES Drawings and data on steel shapes are included in a booklet compiled by the Commercial Shearing and Stamping Company, Youngstown, Ohio.

STEEL SPECIFICATIONS American Iron & Steel Institute and Society of Automotive Engineers specifications for steel are compared in a booklet by the Joseph T. Ryerson & Son, Inc., Box 8000A, Chicago, Ill.

SURFACE PLATES Machine Products Corp., 6771 E. McNichols Rd., Detroit, Mich., has issued a four-page folder of surface plates, angles, cubes, wheels, handles and knobs.

THREAD GRINDERS Two folders describing thread grinders have been published by the Dalzen Tool & Mfg. Co., 511 Leib St., Detroit, Mich.

TOOL METAL Engineering data on bronzes used in the manufacture of small tools are included in folder No. 95 recently published by Ampco Metal, Inc., Milwaukee, Wis.

WELDING POSITIONERS Welding positioners ranging in capacity from 2,500-lb. hand-operated to 8 ton motor-operated machines are illustrated and described in a 12-page bulletin published by Ransome Concrete Machinery Co., Dunellen, N. J.

NEW BOOKS

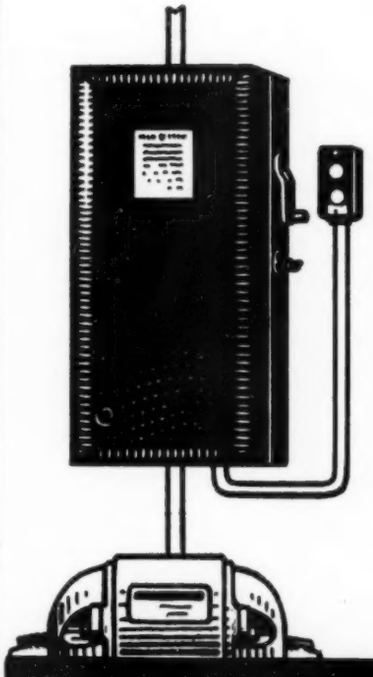
DO YOU WANT TO BE A FOREMAN?—*By Albert Walton, Associate Professor of Psychology, The Pennsylvania State College. 165 pages. Published by McGraw-Hill Book Company, 330 West 42nd Street, New York, N. Y. $1.60.*

This book presents a general picture of supervision to those who aspire to and may qualify for industrial leadership. It is not a scientific treatise of the subject. Rather the author has advanced problems and suggestions that are intended to stimulate the reader to appraise personally his own qualifications for foremanship.

He asks you if you really want promotion, and if you do to place yourself in a foreman's shoes, make a survey of your personal attributes and then prepare a program for self-improvement. In the author's own words you have the tenor of his intention in writing the book: "I hope the book will not be found interesting. I hope it will be

"Our experience shows that it takes less labor to install G-E combination starters than to put in separate devices. And they save on conduit."*

**Statement by Walter B. Atchinson, electrical engineer of a large valve plant*



Here's all an electrician needs to do to install a G-E combination starter

A. Mount one compact starter (not two devices).

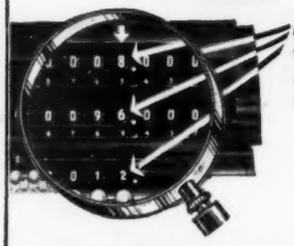
B. Run conduit and pull wires to motor, push-button, and power supply.

C. Make 9 quick connections (not 15) in starter, insert fuses, and—motor is ready to run.

Send for "More for Your Control Dollar" (GES-2456). General Electric, Sec. 676-44, Schenectady, N. Y.

GENERAL ELECTRIC

for calculating
Cylindrical and Ball Gauge Readings
and other uses!



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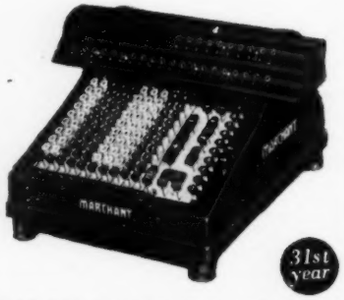
the electric calculator with straight-line true-figure dials for ALL 3 FACTORS!

It's not economical for high-wage employees to figure with pencil and paper, because MARCHANT will give "the answer" in a jiffy... correctly pointed off... with all three factors in plain sight for checking.

This is why MARCHANT is so popular in shop and drafting room ... for all work where slide-rule accuracy does not suffice.

Try an Automatic Electric MARCHANT at our expense. They're priced to fit your job ... budget terms if desired.



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HOME OFFICE: OAKLAND, CALIFORNIA, U. S. A.
Sales Agencies and Manufacturer's Service Stations Give Service Everywhere!

Gentlemen:
- ☐ We wish to try a Marchant at no obligation to us.
- ☐ Send "7 place Natural Trig. Functions with Increments to Seconds" (25 cents in stamps enclosed).
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A. M. 12-10-41

found a bit disturbing, even, perhaps, a mite annoying. If, as you read it, you find it has some such affect on you, you may be fairly well assured that it is because there are some things contained in it that it is good for you to hear and to meet and to take a definite stand upon." He will convince you that there are as many personal problems to meet as there are industrial ones before true success as an industrial leader can be attained.

•

HOW TO TRAIN SHOP WORKERS—*By C. A. Prosser, director, and Philip S. Van Wyck, Metal Trades Department, Dunwoody Institute.* 126 *pages. Published by American Technical Society, Drexel Ave. at* 58 *St, Chicago, Ill.* $1.25.

This shop training manual for use by foremen and instructors in the training of workers in production and service jobs has been prepared to serve a double purpose. It is designed to be helpful to shop foremen in training workers in any mechanical occupation. It also is designed to be of value to shop instructors in all-day, part-time and evening schools and classes. Originally the manual was produced in mimeographed form use by the National Youth Administration in training the foreman on the project work of that organization in the various states. Because it was believed that it would be of special value at this time in connection with training for essential industries, and training within industry, permission has been given by the National Youth Administration for the utilization of the original material through this manual.

Contents of the manual are divided into six parts, covering: (1) the foreman's duties and responsibilities, (2) planning what training to give the worker, (3) finding what to teach by job analysis; (4) methods, procedures and devices for putting over what is to be taught, (5) training the worker right, and (6) the foreman as a human engineer. Charts and tables are used throughout the text to illustrate the principal points.

•

THE FEDERAL WAGE AND HOUR LAW—*By Arthur W. Nevins, attorney and specialist on labor law.* 58 *pages. Published by National Foremen's Institute, Deep River, Conn.* $1.50.

Over three years have passed since the passage by Congress of the Fair Labor Standards Act of 1938, but many firms are running the risk of heavy penalties through unintentional violation of the wage-hour regulations. Most infringements result from an employer's belief that his business is wholly local and outside the scope of the law. The penalty is high, being double payment of back wages due employees. Other firms, conversely are complying with the law when in fact

When Machine Tools CHATTER ... or Bearings and Gears run HOT— use

"STURACO"
EXTREME PRESSURE ("EP")
MACHINERY OILS & GREASES

STICKING ways resulting from overloads means troublesome "chatter." A STURACO ("EP") LUBRICANT will often eliminate the trouble for it has a technically accepted load carrying capacity of over 300% more than ordinary lubricants.

Hot spindle bearings and gear heads can frequently be cooled to operating efficiency when the proper STURACO ("EP") LUBRICANT is applied.

Results from this unusual principle of lubrication have been astonishing. What is your tough problem? Write, wire or phone today!

SEND FOR this new 20 page booklet outlining laboratory research behind this genuine development.

• Work out your metal cutting problems with a STUART OIL Engineer. From the complete STUART line he'll help you choose the proper cutting oil to set you up for top efficiency.

For All Cutting Fluid Problems
D. A. STUART OIL CO.
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Chicago, U.S.A. Est. 1865
Warehouses in All Principal Metal Working Centers

their businesses are local trade unaffected by federal law.

By the question and answer method, the author tells what employees are covered by the law and which are exempted. His answers are based on the most recent rulings handed down by the courts. Other subjects essential to proper understanding of the law are covered: minimum wages, including their determination and allowed deductions; what constitutes working time; overtime wage rates; child labor and the data that must be kept on the employer's records.

•

PRACTICAL LESSONS IN ARC WELDING, PART II—*By W. J. Chaffee. 100 pages. Published by Hobart Brothers Company, Troy, Ohio. 50¢. Spanish edition, $2.00.*

This book covers 42 complete lessons in arc welding patterned after the arc welding course given in the Hobart Trade School. Although each lesson is concise, fundamentals and advanced work are well explained by both text and illustrations.

Group lessons include: striking and manipulating the arc; welding with bare electrodes; welding and cutting with coated electrodes; and welding light-gage steel. Each lesson gives complete instructions for practicing the given exercises, including data on material, position, proper electrode, current value, and polarity setting. Practices for acquiring welding proficiency are stressed—technical material is held to a minimum.

Causes of Welding Troubles

By ARTHUR HAVENS

Welders often complain about the inefficiency of the motor generator they are using. Frequently the trouble will be traced to other causes and even if the trouble lies in the machine it is probably caused from neglect. It is not uncommon to find a motor generator covered with dust and obviously not greased for ages; it is hardly reasonable to expect maximum ampere output under these conditions.

In dusty shops, a welding generator should be blown out thoroughly once each week. Grease cups should be filled regularly. Excess grease should be wiped off for it is apt to run through the bearings and lodge on the field winding of the motor—a great many motors have burned out simply because of the neglect of the electrician or welding operator to check on this simple matter.

Then too, the brushes are often neglected—especially the exciter brushes. The exciter is a very important part of this type welding machine and the commutator and brushes should be maintained in a condition equal to that of the main generator, for without max-

DO-ALL Contour Machine BAND SAWING BAND FILING BAND POLISHING

CUTS THEM ALL—

LARGE

OR SMALL

Steel channel forms like above, equal to armor plate, 15 ft. long, 15" wide, formerly cut on a planer at Koehring Co., Milwaukee, are now cut on the DoAll at a labor saving of $16.50 each.

Group of dies and stampings (right) at Liberty Tool & Die Co., Rochester, N. Y. gives an idea of variety of jobs handled on their DoAll.

VERSATILITY PLUS

Today's fastest method of removing metal—the DoAll cuts any kind of metal or alloy, from hardest high carbon steel to soft brass. Does internal and external band sawing, filing, polishing. Available are 42 different saws, 20 file bands and 3 polishers—a correct one to do each job more efficiently.

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imum voltage output from the exciter full efficiency from the unit as a whole cannot be expected. Here is another place where the excess grease must be wiped off—with the exciter at the end of the drive shaft near the end bearing it is apt to gather a quantity of grease and must be watched constantly.

When an arc-welding generator seems to be losing its efficiency it is well to check the voltage output of the exciter, this may be the answer to a seemingly knotty problem.

A great many of the older motor-generator sets in railroad shops, for example, are of the 200-amp. type and are found to be inadequate for electrodes over 3/16 in. diameter; however, it is not uncommon to find an operator using a ⅛ diameter electrode and claiming that it is all the machine will handle. In one such case the generator was located at one end of a large shop, near a 440-volt outlet while the welding bench was at the other end of the shop. The ground connection was laid on a rail near the machine which in turn was connected to a steam radiator by an iron bar; furthermore, an iron bar served as a means of grounding from the radiator to the welding bench. The electrode cable due to its extreme length was made up of several different types and sizes of wire, few of them suitable for the low voltage current. The whole was fastened together in the most haphazard manner. Surely it is not reasonable to expect maximum amperage under these conditions; in fact, the 200-amp. generator in this case was supplying barely enough current to the welding bench to melt a ⅛-in. electrode.

This condition was cured in the following manner: additional 440-volt outlets were installed, but pending the installation a 150-ft. triple conduit lead was fastened to the motor and two 65 ft. 1-0 extra flexible cables for ground and electrode were attached to the generator. With no further ado the generator that was supposed to be worn out supplied correct current for a ¼-in. electrode. This is just a sample of what common sense can do.

Vibration Dampener For Intermittent Cuts

The shock of a half-round rotor striking the turning tools at each revolution has been reduced by three means: (1) setting the four turning tools at staggered heights, (2) using tool shanks 1 x 2 in. in section, and (3) application of a friction-type vibration dampener to the lathe's faceplate. This dampener is a piece of 3-in. leather belting, one end fixed to a block at the rear of the lathe, the middle portion riding on a pulley-like surface on the faceplate, and the free end carrying a heavy lead weight at the front of the machine. Instead of hesitating as the work hits the tools, and then "falling forward," the faceplate runs smoothly. There is little noticeable jar and work speed has been doubled to approximately 15 r.p.m., the cemented carbide tools cutting at 165 surface ft. per min., 0.014 in. feed and ½ in. depth of cut. The rotor is an armor-steel casting weighing several hundred pounds.

Subcontracts Wanted

With priorities established by the government on all metals, many machine shops are having difficulty securing material for the production of commercial items that represented the bulk of their work prior to the beginning of the national defense program. This is particularly true in the metropolitan area of New York City where hundreds of machine shops are working far below capacity; in fact, some of them are confronted with the possibility of going out of business.

These shops are looking for subcontracts on defense work; however, the number of prime contractors in the metropolitan area are so few that the capacity of individual machine shops in the area cannot possibly be utilized. Some of the shops are at present engaged in making plug gages, snap gages, thread gages, jigs, fixtures and cutting tools for large manufacturing concerns. Others are engaged in the production of single parts and subassemblies of ordnance equipment, machine tools, metal-working equipment, and parts for aircraft engines, airplane accessories, heat-treating furnaces, and other equipment having a direct bearing on the national defense program.

At a recent subcontract meeting conducted by the American Society of Mechanical Engineers, the owners of 250 machine shops, sheet-metal shops and welding companies attended. All were looking for work. Speakers from the Office of Production Management, the New York State Division of Commerce and companies which have successfully obtained subcontracts for defense work were asked to explain why small shops excellently equipped and with expert personnel could not secure work. The question has not yet been answered adequately.

The Contract Distribution Service of the Office of Production Management, as well as the New York State Division of Commerce, and the Procurement Divisions of the Army, Navy and Air Corps, have and are still attempting to classify available machine shops and allocate subcontract work to them. Even with such service available to machine shop owners, the number of subcontracts actually placed through such means have been pitifully small.

Can it be that there is not enough defense work to keep these shops busy? This question has been asked of men interested in allocating subcontracts, and the answer has invariably been "yes". Try to explain this to the small shop owner. He won't listen. He can't be blamed, because publicity out of

Washington during the months passed has reiterated that it is essential every machine tool be put to work on defense work. Daily the impression is growing that such publicity was and still is unwarranted.

Nevertheless, there are many excellent shops available throughout the country which are willing and ready to assume production of defense work on a subcontract basis. The extent to which these can be used undoubtedly depends upon prime contractors' willingness to secure outside help for production of individual parts and subassemblies of defense items, as well as gages, jigs and fixtures. The prime contractors have, of course, a defensible argument in not subcontracting work extensively—they have expanded plants, increased their inventories of production equipment, added to their personnel, inaugurated training courses for unskilled help and otherwise improved facilities for production of war equipment in their own plants. The investments in such improvements have been great, and the extent to which subcontracts can be let is governed considerably by the necessity of keeping their plants in operation sufficiently long to provide a return on the investment involved. On the other hand, some companies have not expanded much, and have based their production on the allocation of subcontracts.

The great number of prime contracts now being let for war equipment, and the need for haste in its production, will, no doubt, necessitate greater use of the smaller machine shops throughout the country. The prime contractors involved might well study the availability of small shops in large industrial areas. Here indeed is fertile ground for the distribution of subcontracts by large companies seeking to allocate some of their production.

Always Question Drawings

Everyone makes mistakes, and it's only natural to get sore when you get blamed for somebody else's. But settling resultant feuds, such as between drafting rooms and the shop, by laying down iron-clad rules is seldom the best way out. If a skilled toolmaker, for instance, is denied the privilege of questioning the dimensions on a blueprint, comical—and expensive—consequences can be expected.

This was demonstrated recently in a large eastern shop doing contract experimental work. The hard-and-fast rule was that shop men were to follow drawings to the letter, with no questions asked. One model under construction required 200 small steel blocks, each with a hole through its center. The machinist who was put to making these blocks eventually dumped a few handfuls of crescent-shaped parts on his foreman's desk. Before his boss could blow up, however, he pointed to the blue print—which, sure enough, called for a ½-in. hole in a ⅜-in. block!

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"THE LIGHT WEIGHT and extremely small O.D. of the Torrington Needle Bearing permits reduction in dimensions and weight of surrounding members," Bell engineers state, adding, "For its size, the Needle Bearing is found to be more efficient and has greater capacity than any other type of bearing." Also used in the aileron quadrant of Bell Airacobras, Needle Bearings have large lubricant capacity.

If you have a bearing problem where high load capacity, small size, light weight, ease of assembly, and lubrication are important, investigate the advantages of the Torrington Needle Bearing. Our Engineering Department will gladly work with you in adapting these advantages to your assemblies. For detailed information write for Catalog No. 105. For Needle Bearings to be used in heavier service, write our associate, Bantam Bearings Corporation, South Bend, Indiana, for Booklet 104X.

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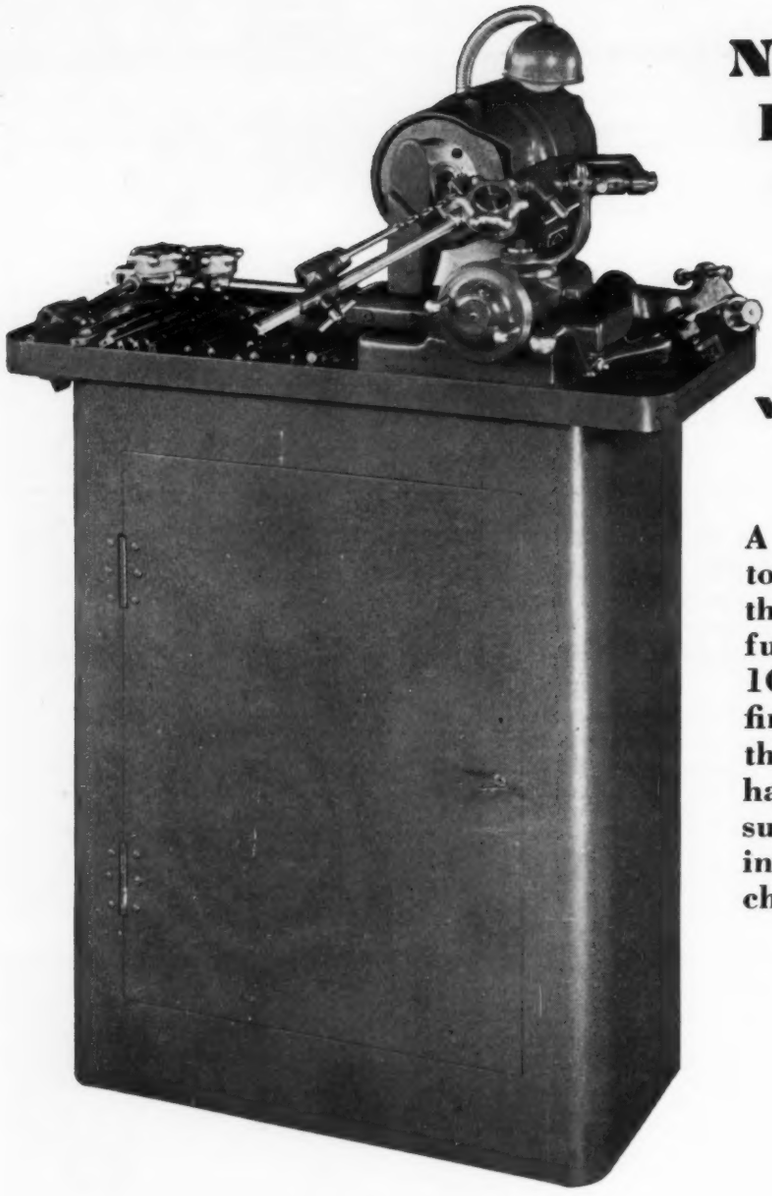

New Convenient Drill Grinding Combination

•

Sellers No. 1G Drill Grinder with steel cabinet pedestal

A new convenience for operators engaged in drill grinding is the steel cabinet pedestal now furnished with the Sellers Model 1G Drill Grinder. It forms a firm, substantial pedestal for the grinder and the work, and a handy cabinet in which to store supplies and attachments. Cabinet and grinder may be purchased separately, if desired.

The Sellers Model 1G Drill Grinder will grind drills from No. 70 (.028″) to ½″ and produces accurate drill points of 160 to 65 degrees included angle —perfect drill points with equal identical lips. Speeds production. Saves skilled labor for production machine work. Saves drills. Write for catalog and prices.

The cabinet has a working space 13″ wide by 30″ long and stands 31″ from the floor. It is of heavy sheet steel, rigidly constructed and braced to form a vibrationless mount for the grinder. There are three shelves of wood (to avoid defacing tools) with a hinged door and fastener. Finish is standard machine tool gray. Weight 175 lbs.

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